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ABSTRACT

Presented is a summary of the current state of science teacher education based on questionnaire responses gathered in 1972 from American and Canadian colleges and universities. The document consists of four sections. The first three sections are concerned with programs and courses offered for K-12, elementary, and secondary school teachers. A specified schema format is used to analyze the programs in terms of content, strategy, outcome, and evidence. Five types of information are provided for each institution: the name and location of the institution, name and address of the information supplier, program descriptions, analytical results presented in the schema format, and lists of available materials. The fourth section contains responses which cannot be adapted to the format. The authors indicate that the schema presentation is designed to provide opportunities of examining the role of performance-based teacher education programs in connection with their intended outcomes and evidence of their objective attainment. The document is published through the joint effort of the Association for Education of Teachers in Science and the ERIC Information Analysis Center for Science, Mathematics, and Environmental Education at the Ohio State University. (CC)

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SE 015 832

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IN SEARCH OF PROMISING PRACTICES

IN

SCIENCE TEACHER EDUCATION

AETS PUBLICATIONS COMMITTEE, 1972-73
Douglas A. Roberts, Chairman
Patricia E. Blosser
Ronald J. Raven
Alan M. Voelker
Ronald D. Anderson, _ex officio_

PREPARED FOR A FORUM ON SCIENCE TEACHER EDUCATION
ASSOCIATION FOR THE EDUCATION OF TEACHERS IN SCIENCE
NATIONAL SCIENCE TEACHERS ASSOCIATION ANNUAL MEETING
DETROIT, MICHIGAN
March 30, 1973

ERIC Information Analysis Center for
Science, Mathematics, and Environmental Education
400 Lincoln Tower
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Columbus, Ohio 43210

PREFACE

In October, 1972, the ERIC Information Analysis Center for Science, Mathematics, and Environmental Education sponsored a planning conference for the Publications Committee of the Association for the Education of Teachers in Science to discuss possible projects which would provide service to the science education profession. Because the roles of science teacher education are under reexamination today and because program practices are changing, the planning conference participants decided to seek information about current science teacher education programs and courses.

Program and course descriptions were solicited from colleges and universities throughout the United States and Canada. This publication is the result of the information which was received. The responses have been grouped into four sections in this document. In each section the responses are listed alphabetically by name of institution.

All responses have been included as received, except for minor editing and abbreviation of some lengthy submissions. The reader is invited to analyze the material and to extract what he considers useful.

The papers indicate that the respondents have been involved in analyzing and restructuring both the content and format of science teacher education programs. ERIC/SMEAC is pleased to have been able to provide for the dissemination of these program descriptions.

Patricia E. Blosser
Research Associate
Science Education

March, 1973

Sponsored by the Educational Resources Information Center of the United States Office of Education and The Ohio State University.

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FOREWORD

Overview

This publication is the product of a cooperative venture between the Association for the Education of Teachers in Science and the ERIC Information Analysis Center for Science, Mathematics and Environmental Education at The Ohio State University. The project was undertaken to obtain information about the current state of science teacher education and to seek out practices - conceptual and operational - which appear to have promise. Information obtained will (a) describe the state of the art, (b) provide awareness of issues related to performance-based certification, (c) identify resource and reference materials for science teacher education programs, and (d) provide intellectual leadership for the profession.

The information reported is the yield of responses to a questionnaire sent to all AETS members (approximately 600) and to a sample (approximately 400) of the membership of the American Association of Colleges for Teacher Education. This mailing was completed in November, 1972. Recipients of the questionnaire were asked to prepare a general description of their program and to analyze some portion of the program, using a schema provided with the questionnaire.

Structure of the Document

This document has four sections. The first three sections (K-12, elementary, secondary) contain responses which were submitted according to the required format. The fourth section (appendix) contains responses which could not be adapted to the format but which are of potential interest to readers who may wish to contact the specific institution for information.

For each institution, the information is presented in the following sequence:

name and location of the institution
name and address of individual providing information
brief program description
schema format
list of available materials.

Not all responses contained all five types of information. In some instances, the schema was supplied without an accompanying program description or vice versa.

Analysis Schema

A schema proposed by one member of the AETS Publications Committee (Roberts) was used as a means for analyzing the content of science teacher education programs or courses. The schema was chosen as the format for analysis for two major reasons. First, Roberts had used it, modified it, and found it helpful in a variety of curriculum contexts over a period of years. It forces distinctions while presenting a simple view of elements of program design and their relationships.

The schema takes the form of an equation, roughly, and relates elements of a program in the following way:

$$\boxed{\text{CONTENT}} + \boxed{\text{STRATEGY}} \rightarrow \boxed{\text{OUTCOME(S)}} \rightleftharpoons \boxed{\text{EVIDENCE}}$$

Questionnaire respondents were asked to complete a four-column format and were asked to list under:

CONTENT	one or more major idea(s) from the conceptual framework for your science teacher education
STRATEGY	for each major idea, the teaching strategy used (NOT just the "method" used to implement the idea)
OUTCOME(S)	from the major idea and strategy stated, list the outcome(s) you intend for your teacher candidates
EVIDENCE	the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s)

A second reason for using the schema relates to the fact that performance-based teacher education is gaining momentum in the planning and conduct of science teacher education programs. The schema permits one to examine the role of performance-based teacher education by requiring anyone analyzing a program to distinguish between the intended outcomes and evidence of their attainment. For example, performance-based teacher education purports to emphasize attainment of intended outcomes and perhaps pays too little attention to determining what these outcomes should be. Perhaps it may pay too little attention to the relationship between outcomes and evidence. Sometimes the outcomes and evidence are assumed to be identical. The AETS Publication Committee wishes to point out this important aspect of conceptualizing the relationship between objectives and their attainment.

AETS Publications Committee, 1972-73
Douglas A. Roberts, Chairman
Patricia E. Blosser
Ronald J. Raven
Alan M. Voelker
Ronald D. Anderson, *ex officio*

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SECTION ONE: K-12 SCIENCE TEACHER EDUCATION PROGRAMS

THE ONTARIO INSTITUTE FOR STUDIES IN EDUCATION
Toronto, Ontario, Canada

Douglas A. Roberts, F. Michael Connelly, Douglas Campbell
Department of Curriculum
The Ontario Institute for Studies in Education
252 Bloor Street West
Toronto, Ontario, Canada M5S IV6
(Telephone: 416-923-6641)

PROGRAM DESCRIPTION (Inservice):

Inservice science teacher education programs at The Ontario Institute for Studies in Education are conducted within the general framework of the M.Ed. program in the Department of Curriculum, and are individually tailored to specific needs and interests of candidates. The degree program requires eight courses, and six options are available in science education. Courses in science education are generally oriented around philosophical analysis of science as a school subject; ways to make sense out of the events of science teaching, through analytical schemes considering both content and process of teaching and learning; and rationale, justification, implementation and evaluation of a variety of approaches to science in the school curriculum. The course options are designed for elementary and secondary teachers, department heads, principals, curriculum consultants, and science teacher educators.

AVAILABLE MATERIALS:

Collections of readings, classroom transcriptions, reading lists, etc. are available on a limited basis from the three instructors.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Science eventuates in knowledge which is based on a disciplined process. Theory of knowledge (epistemology) is helpful, in part, for a teacher candidate to understand how scientific knowledge comes about, and how pupils learn it.	Directed analysis of transcribed classroom dialogue enables the professor to teach candidates how to identify teacher's and pupils' statements and questions according to their epistemological function: as evidence, backing for conclusion, etc. In this way, what is being taught can be related to its basis in the discipline of science.

→ OUTCOME(S)	⇄ EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The candidate understands that a teacher is both AN authority (on a discipline), and IN authority (by social contract). Further, he understands that pupils sometimes accept what he says on the latter basis, when he thinks they understand what he says on the former.	The candidate can be observed increasingly to make provision for pupils to relate evidence, backing, truth strategies, etc., to the knowledge claims he is teaching. The candidate can be observed less and less to have the pupils accept the knowledge claims he is teaching on the basis of his socially determined authority (that is, by default).

SOUTHWEST MINNESOTA STATE COLLEGE
Marshall, Minnesota

Leo H. Bowman
Southwest Minnesota State College
Marshall, Minnesota 56258
(Telephone: 507-537-7217)

PROGRAM DESCRIPTION (Preservice):

The Southwest Minnesota State College experiment is a cooperative effort with the Physical Science Group, formerly the Education Development Center, of Newton, Massachusetts. The goal of the program is to develop better trained teachers of science-elementary science specialists, junior high physical scientists, and high school physics and chemistry teachers - who are versatile and adaptable.

The program encompasses an entire four year, interdisciplinary format. Cooperating departments included in the major thrust are English, education, mathematics, physics, and chemistry. New courses, textual materials, laboratory experiments, and equipment have been developed.

Features of the program include an inquiry centered teaching mode with its accompanying informal laboratory-discussion-seminar classroom environment, "intramural" teaching experience immediately as freshman and throughout the curriculum, early exposure to public schools, integration of many aspects of professional education into the science classroom, coordination of the student's mathematics training with the requirements imposed by his science courses, and the development of a sense of comradship and pride at the prospects of becoming science teachers.

The freshman level requires the student to enroll in a coordinated English, mathematics, and physical science sequence. The physical science textual materials include College Introductory Physical science, Physical Science II, and some PSSC Physics. A concerted effort is made to elevate the student's self concept during this first, elementary science exposure. The inquiry approach, pooling of group data, self teaching, and an almost hundred per cent success ratio on the experiments have proven effective. Students seem to come out with positive attitudes. They seem less hesitant to attack new situations than students taught along more traditional lines.

The remainder of the sequence generally follows the same teaching pattern. The mathematics runs parallel through the junior year. Physics and chemistry are split out into separate courses at the sophomore level and again combined in a four quarter junior-senior sequence. A shop course is introduced. Aspects of formal professional education which have not been conveniently incorporated into the science sequence are completed via competency based learning packages. The program culminates with a theoretical physics course and practice

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Inherent in science is a systematic approach to problem solving: observing, analyzing, hypothesizing, model building, model testing, and generalizing. An effective teacher candidate must understand this process and be able to discriminate between these developmental stages if he is to transmit the process to his students.	A series of progressive, structured experiments are conducted. These experiments lead to a definite and provable conclusion. The students and professional alternately assume the role of learner and instructor via an informal, inquiry centered environment.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The candidate learns to discriminate fact from claims. The candidate becomes an acute observer. The candidate analyses his actions. The candidate learns to work cooperatively in partnership with others.	Given a set of experimental circumstances the student 1. challenges conclusions drawn by others and demands proof, 2. proposes alternative avenues for confirming conclusions, 3. can guide his peers in meaningful discussion, which ultimately leads to a reasonable end.

teaching. Obviously, the student is responsible for completing the institutional liberal arts requirements and is expected to complement his training with judicious choices of elective courses.

A number of laboratory innovations have resulted from this cooperative. In addition to the, by now, relatively well known CIPS, PSII, and P.S.S.C. developments of inexpensive, yet effective, laboratory devices, two more recent innovations are notable: an inexpensive infrared spectrophotometer and a pH meter. Both units are designed to minimize the "black box" aspects of instrumentation, while also serving as basic analytical tools.

AVAILABLE MATERIALS:

Inexpensive pH meter

Inexpensive I.R. Spectrophotometer

Mathematics Materials for Science Students: (Only preliminary, pilot edition in print)

Experiment Chemistry: (Only preliminary, pilot edition in print)

For materials, contact: Dr. Gerald Abegg
Physical Science Group
Newton College of the Sacred Heart
Newton, Massachusetts 02159

THE UNIVERSITY OF TEXAS RESEARCH AND DEVELOPMENT CENTER FOR TEACHER EDUCATION
Austin, Texas

Gene E. Hall
Research and Development Center for
Teacher Education
3.214 Education Annex
The University of Texas
Austin, Texas 78712
(Telephone: 512-471-2344)

PROGRAM DESCRIPTION (K-12): not provided.

AVAILABLE MATERIALS:

Analysis of Teaching Behavior: procedures for training teachers in a 14 category process-oriented system of interaction analysis. $1.50

Electrical Circuits and Videotape Feedback: presentation of a model lesson and some suggested strategies for approaching conferences based on videotapes of students teaching. $.75

Overview of the Comprehensive Personal Assessment System: description of the personal assessment and feedback procedures developed at the University of Texas Research and Development Center. $1.00

Self-Confrontation Counselling: A Selective Review to 1972 with Implications for Teacher Education: literature review with implications for videotape feedback procedures. $1.50

For materials, contact Dr. Hall at the address given above.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Personalization: the individualization of education based on the personal needs of the learner as well as his cognitive needs. The developmental concept of Concerns of Teachers is employed as a basis for sequencing instruction. Interdisciplinary faculty teaming The use of a counselor as a key faculty member Videotape feedback, using a counselor and curriculum faculty pair	Teacher education training and program design that enhances teaming. Using a set of University of Texas Research and Development Center developed assessment instruments, the counselor provides a Personal Assessment Feedback conference to each student Both faculty meet with the individual student to critique a videotape of the student teaching

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Teachers are first concerned about themselves and the situation, so present related instruction	Reduced concern about being able to survive and confidence in being able to handle the situation
Less redundance between instructors. More continuity in program	Students and faculty feel they know more about each other and a lot is expected
The student has increased self-knowledge and is better able to assess his capability as a teacher	Better able to evaluate his own teaching and interactive skills
Increased skill as a teacher in terms of interactive behaviors and attention to personal needs of his pupils	Assessment of teacher's performance by the pupils in his class

UNIVERSITY OF WISCONSIN-MADISON
Madison, Wisconsin

Alan M. Voelker
Box 64, Education Building
University of Wisconsin
Madison, Wisconsin 53707
(Telephone: 608-262-3530
or 262-1711)

PROGRAM DESCRIPTION (Preservice, inservice):

All science teacher preparation programs at the University of Wisconsin-Madison result from joint efforts of academicians, educationists and scholars in general education. Initial program designs are developed by an appropriate committee of science scholars and science educators and submitted to the total university faculty for modification or approval. This procedure is followed because the teacher preparation program at the University of Wisconsin is considered a responsibility of the total university: scientists, humanists, historians, economists, psychologists, engineers, educationists, etc. The approach allows the programs to grow in a realistic stable fashion, withstanding buffeting from untested passing fads. It also reflects the position that the programs must educate for personal life as well as the profession to be practiced.

Every science teacher has an educational obligation which becomes the base for the teacher preparation program. That obligation is bringing the student and his environments, particularly the natural environment, together at a functional level. We see science as an effective way of interpreting natural phenomena. In the total preparation of the science teacher, science is viewed as a way of studying natural phenomena, man's understanding of natural phenomena, and man's way of using knowledge in his daily life.

One part of the teaching of science involves knowledge of the conceptual structure of science, the philosophic structure of science and the relationship of science to society. This phase of the program is, of necessity, the province of scholars in the discipline.

A second part involves the teaching act as it relates to how people come to possess different kinds of knowledges, skills, habits and/or attitudes. Such factors include the structure for teaching, a psychology of learning, and a philosophy of curriculum development. This part is the province of scholars in the respective areas.

A third part of the program lies with the "general education" of the prospective teacher, often described as literature, art, social studies. These experiences reveal to the prospective teacher that science is essentially one of the humanities.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
In order to facilitate children's learning of science it is necessary to understand the interrelationships and interdependencies of a structure of science, interpretations of children as learners and conceived behaviors of instructional personnel. This requires that the teacher candidate (1) understand the conceptual knowledge of science, the means by which science gathers, generates, and evaluates this knowledge, and the means by which these knowledges and skills are applied to problems of daily living; (2) understand the results of research in science education and education regarding the nature of concept learning, skills acquisition, and attitude formation; and (3) understand the results of research on the nature of the teaching act.	Teacher candidates interact with children, peers, experienced teachers and university research scholars from the sciences, social sciences, humanities, science education and educational foundations in hypothetical and simulated field-clinical experiences. This enables the candidate to identify the basic elements of instructional strategies when planning for the teaching of science. Findings of scholars in science, science education, and educational foundations are utilized in diagnosing children's learning problems and analyzing their developmental patterns.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The candidate is able to analyze conceptual schemes related to the several dimensions of science and identify those aspects appropriate to learners of specified characteristics and then develop learning sequences appropriate to these learners.	1. The teacher is accepted as both an academician and an educationist.
2. The candidate is able to apply research knowledge from science and education to diagnose children's learning problems in science.	2. Through the use of hypothesized and simulated situations such as microteaching, the candidates demonstrate the ability to design instructional sequences, analyze feedback data regarding student learning as a reflection of their own behaviors, and employ this information in redesigning these sequences.
3. The candidate is able to identify and utilize techniques for improving his own teaching behaviors.	3. In a variety of clinical settings, the candidate designs and implements science learning sequences which demonstrate a recognition of the aforementioned interrelationships and interdependencies. Their application in a particular instructional context provides further evidence that these competencies have been acquired.

AVAILABLE MATERIALS:

Ten minute science microteaching video tapes - all sciences. 6-8th grades. Send blank 1" or 1/2" tape. We will dub from our master to your blank. We have Ampex and Sony equipment.

Videotaped teaching credentials (Samples). Teacher candidates have made a collage of teaching situations for employer references. Send blank 1" or 1/2" tape. We will dub from our master to your blank. We have Ampex and Sony equipment.

Learning package for secondary science teachers. Includes objectives, activities and evaluation measures for both the methods course and the practicum experience.

For materials write to: Dr. Miles A. Nelson
Teacher Education Building
225 N. Mills Street
Madison, Wisconsin 53706

SECTION TWO: ELEMENTARY SCHOOL SCIENCE TEACHER EDUCATION PROGRAMS

THE AMERICAN UNIVERSITY
Washington, D.C.

Leo Schubert
Chemistry Department
The American University
Washington, D.C. 20016
(Telephone: 202-686-2332)

PROGRAM DESCRIPTION (Preservice):

Not provided.

AVAILABLE MATERIALS:

Introductory Science: A Chemistry Department Institutes A Science Education Program. (Reprinted from the Journal of College Science Teaching, February, 1972.)

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Elementary school teachers are needed with appropriate science content experience and sensitivity to the philosophies involved in teaching the curricula developed by the science curriculum improvement groups.	A course was designed at The American University by the Chemistry Department. It is a preservice science course required of all students majoring in elementary education. It is fundamentally one in science content which was determined by melding the material used in four, nationally-funded, elementary school science curricula: Science Curriculum Improvement Study (SCIS), Science-A Process Approach (SAPA), Conceptually Oriented Programs in Elementary Science (COPES), and Elementary School Science (ESS). The laboratory work employs the same kits, equipment, and activities as are used in these national programs. Sufficient skills and content mastery are developed to enable the student to teach science to a class of children (as distinguished from microteaching) during the course. The student has the option of selecting the materials and the lesson to be taught.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. Candidates gain necessary science content experience.	1. Test results
2. They become sensitive to the philosophies involved in teaching the curricula developed by the science improvement groups.	2. Observation of students teaching the children.
3. They become knowledgeable and perceptive about the approaches which scientists find useful in studying scientific phenomena.	3. Test results of children.
4. They learn a science curriculum which they may choose to implement as elementary school teachers.	

AUSTIN PEAY STATE UNIVERSITY
Clarksville, Tennessee

Carl Stedman
Austin Peay State University
Clarksville, Tennessee 37040
(Telephone: 615-648-1497)

PROGRAM DESCRIPTION (Preservice):

Preservice teachers in elementary education are currently required to take one year of science as part of their core requirements at Austin Peay State University. After admission to the School of Education, they are required to take an additional sequence of three courses in science which are specifically designed for them and for which they receive nine hours of credit. Although these courses are identified as earth science, physical science and life science, methodology is heavily integrated into the sequence and no special methods course in science is required. The following presentation is directed to this three quarter sequence in science education.

Basic Assumptions and Skeletal Program:

Two comprehensive principles affect the planning and teaching throughout the sequence: (1) it is assumed to be of prime importance that science should be presented to preservice elementary teachers in a way similar to the way they will eventually be expected to teach it, and (2) it is further assumed that students learn best in a teaching-learning environment which enables them to become personally involved and active in their learning.

These two assumptions are viewed as having special importance because of the generally accepted belief that "teachers teach as they have been taught." To state this posture briefly, it is assumed that you do not encourage preservice teachers to eventually deal with science as an investigative enterprise in their own classrooms by lecturing to them about the merits of this approach.

(Continued on p. 21)

AVAILABLE MATERIALS:

Preparing an instructional package of science materials for elementary school children: (note: general guidelines appropriate for high school also). Send self-addressed and stamped envelope.

For materials, contact Dr. Stedman at above given address.

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Individualizing science instruction demands an understanding of sequencing instruction, specific methodological procedures, and communication skills.	Preservice teachers will develop their own instructional package of learning guides and materials. The package will be designed for a specific grade and ability level, and it will follow a field-test, revision, field-test cycle with elementary school children serving as subjects.
Preservice teachers should develop a conceptual understanding of the nature of scientific investigation and the process skills necessary to pursue truth, and should be able to relate this appropriately to children.	Preservice teachers engage in specific activities to learn process skills, to analyze research strategies and reports in terms of the adequacy of the processes employed, and plan, organize and conduct an investigation which would be appropriate for an elementary school child to pursue or to participate in as an assistant investigator with teacher guidance. Students must identify those processes which children can participate in and the role the child will play in the total investigation, with special emphasis on the concrete rather than the abstract elements of the investigation.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The preservice teachers learn that careful planning and adequate communication is essential in successful instruction; that successful student learning is as much the responsibility of the teacher as the student; and that students are capable of self-learning if they are provided with interesting and adequately prepared instructional materials.	1. A prepared instructional package with specific objectives, a sequenced design to satisfy these objectives and active student involvement provisions; plus an evaluation instrument to measure the objectives. 2. A list of specific revisions made after the field test with a rationale for these revisions provided. 3. Successful completion of the package by a child after the initial field test.
The preservice teacher confronts a situation where abstract thinking must be differentiated from concrete operations in pursuing investigative questions generated by children or arbitrarily by the teacher. They also participate in a learning situation with children rather than for children which will generate the idea that science is an active search for data.	Preservice teachers will: 1) state a hypothesis, identify the controlled, responding and manipulated variables, design an experiment, conduct it, collect and communicate data and draw legitimate conclusions; 2) identify those aspects of the investigation which will be primarily handled by themselves and those performed by the children; and 3) identify the limitations of their approach and state why their conclusions must be regarded as tentative.

PROGRAM DESCRIPTION (Continued):

Skeletal Program

COURSE	MAJOR "CONTENT"	METHODOLOGICAL EMPHASIS
Course I	Nature of Science Basic Earth Science Concepts & Principles	Large group instruction Lesson plan preparation Teaching a lesson to peers and/or children
Course II	Basic Physical Science Concepts & Principles Individualized Instr. Learning theory	Small group lab work Individualized instruction Preparing and field testing an instructional package Textbook examinations for evaluation of topics & methods of presentation vs. learning theory
Course III	Basic science processes Conducting investigations Ecological field activities	Conducting a simple investigation; New Curricula; Process lab activities

Description of Courses:

Course I:Earth Science

Course one has three basic emphases: the nature of science, basic concepts of earth science, and large group teaching strategies. Students are initially led to develop a personal understanding of the nature of science and prepare a written statement of their own philosophy of science. Various individuals' definitions of science and philosophical perspectives are reviewed and discussed, and attention is given to the EPC document, "Education and the Spirit of Science." As various definitions and statements about science are reviewed, the students are asked to translate their meaning in terms of how science should be presented to elementary school children.

The "coverage" in earth science is decided through a cooperative effort between the instructor and students. Small groups or teams are formed and meet with the instructor to make initial plans for presenting some conceptual area of earth science to the class. After these initial meetings, each student in the group begins to plan and develop his own mini-lesson and the majority of the students schedule one or more individual conferences with the instructor for further assistance. During the time that the students are planning for their presentation, classroom instruction is designed to assist them in these efforts. For example, such areas as writing objectives and planning evaluation for them, strategies for achieving maximum student involvement, organization and management of the classroom for instruction and similar instructional components that are directly related to the eventual task the students will perform are stressed.

Also, prior to the presentations by the students, the instructor teaches a number of model lessons in which a variety of techniques, strategies and materials are illustrated. A major commitment to get other students involved personally in their mini-lesson is accepted by each student. Evaluation sessions are scheduled at intervals during the student teaching sessions so that their successes and failures can be reviewed and discussed. The intent is to constructively criticize so that teaching competency and self-evaluation skills will be increased positively.

One important rationale for beginning this sequence with a group instruction methodology is that the majority of the students have come from traditionally oriented school systems. An attempt is therefore made to begin with the familiar and progress to the unfamiliar, i.e. individualized, self-directed and problem solving methodologies.

During this past year, approximately fifteen percent of the students also taught their mini-lesson in local classrooms. Although this extension of the course is now voluntary, it is hoped that more local classrooms will be made available in the future so that all of the preservice teachers have a similar opportunity to work directly with elementary school children.

Course II: Physical Science

Organization of the course in physical science consists of two general phases: a preliminary-planning phase which deals with the learnings associated with the construction of instructional lessons and materials for children, and the "content" phase which consists of some of the basic ideas of physical science which are appropriate for inclusion in elementary school science programs.

Students are introduced to the theoretical aspects of learning theory and how this theory can be implemented in developing an individualized instructional package of learning materials for children. Students also study physical science through three different methodologies: (1) individualized carrel experiences which perform the dual function of serving as instructional package exemplars; (2) small group lab session; and (3) independent library work.

Each student begins by selecting an area of instruction and grade level for developing an instructional package. This package consists of: 1) a set of objectives; 2) an evaluation instrument; 3) a collection of materials and supplies necessary for the instructional experience; and, 4) a single topic or idea which can be developed in about thirty to forty-five minutes. Students are free to develop a package that is oriented toward cognitive outcomes or affective ones, toward content or process, or toward some combination of the content-process-technology-social implication maze of science teaching. After completion, the product is field tested on an elementary school child. Problems are carefully noted, revisions are made and another field test is planned.

Carrels were set up in the room for the individualized instruction in physical science. Cafeteria tables served as a base for peg board and fiberboard partitions and each table served as a base for two carrels. Topics included some of the basic concepts developed in CIPS such as mass and weight, density, heat and thermal expansion of liquids and solids plus additional concepts such as levers and mechanical advantage, the difference between observation and inference, the chemical nature of acids and bases, etc.

Small group lab sessions were conducted around the ideas of inquiry and problem solving, series and parallel circuits, kinetic and potential energy, force and work. COPES materials were integrated into the instruction for energy, force and work.

After about three weeks of group instruction, the class was divided into four sub-groups. One group would work on the carrel activities during the regular class period, another would work in the library analyzing elementary science texts in terms of sequencing instruction and learning theory applications, and two groups would work with the instructor in small group lab sessions. The groups were rotated and class attendance was expected for the lab-discussion group, but the carrel activities and library work could be completed at the student's convenience.

Course III: Life Science

Course three provides more individual freedom and the students work on several investigations of their choice. A supporting rationale for this methodology is based upon the premises that: 1) they have been progressively developing skills and attitudes for self learning, 2) they have developed a more comprehensive understanding of the nature of science and the processes used in investigating problems of interest, and 3) most of the students have taken a formal course in biological science and have a more adequate conceptual background in this discipline.

Each student selects one or two problem areas within a life science context and does independent study in this area of interest. Most of these efforts are expended through reading independently and a paper is written which summarizes these efforts.

Several noteworthy exceptions to this approach have been the conducting of interviews to assess community attitudes toward sex education, abortion and birth control; the preparation of a slide presentation concerning local pollution problems; the building of a portable greenhouse that could be used in an elementary school classroom; efforts to review and prepare ecological classroom materials, and visitations to local science classrooms to assess various teaching strategies.

Students are also asked to conduct a simple investigation of a problem solving nature in the life science area. These investigations take on a "science project" flavor, are usually of short duration, and require practice with such processes as hypothesis formation, data collecting and communicating, data interpretation, and formulating conclusions. Such problems as the amount of water needed by a geranium, the oxygen production of various aquatic plants, bacterial counts above and below a source of local water pollution, and an analysis of dust particles in various samples of air are just a few of the investigations that have been conducted in the past.

The majority of the class instructional time is devoted to the procedures for conducting an investigation, outdoor ecological field studies for elementary school children, and the detailed examination of the new curricula recently made available, with emphasis on ESS, SCIS and S-APA.

CALIFORNIA STATE COLLEGE
Bakersfield, California

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PROGRAM DESCRIPTION (Preservice, inservice):

The science and mathematics teacher education program at California State College at Bakersfield is based on a model being developed with the aid of a grant from the National Science Foundation. The model has three components: a preservice component, an inservice component, and a student teaching component.

The preservice component is part of the normal preparation of elementary teachers which consists of professional preparation courses, methods courses in social studies and language arts, as well as a science/mathematics methods course. The science/mathematics methods course is team taught by a specialist in science education and one in mathematics education. The course has three phases: 1) activities, 2) a philosophical orientation, and 3) a study of the cognitive characteristics of children. The activities are problems which are posed to students for in-depth study. As an example, the teacher candidate might be challenged to "make a burglar alarm system which would be both practical and inexpensive to make." In the course of examining this problem students will deal with concepts involving science, mathematics, social studies, and other areas. He will also design and manufacture a system using materials and tools from a design laboratory (metal and woodworking shop) which is available to him. Although the burglar alarm activity is an idea of the USMES* project, materials and ideas from ESS, SCIS, and S-APA are also used. The purpose of these activities is: 1) to expose teacher candidates to a concrete example of a model of teaching, 2) to examine scientific/mathematical systems, 3) to help gain insights into learning processes, and 4) to provide examples of materials appropriate for use with elementary children. The activities all have the following characteristics: 1) they involve in depth study of "real" problems, 2) the emphasis is on the processes involved, 3) the problems cut across normal subject matter boundaries, 4) the problems are activity-centered, mostly involving manipulative materials, and 5) they involve students in making decisions about the direction of activities.

The second phase of the inservice component is a philosophical orientation. Although philosophy is dealt with during the activities phase, it is also dealt with in the abstract through readings. These readings include books like Holt's How Children Fail and Postman and Weingartner's Teaching as a Subversive Activity as well as papers by Glasser, Bruner, and others. The third phase is the study of the intellectual characteristics of children. This phase includes the interviewing of children using Piaget-type tasks in order to study the variety and type of intellectual strategies available to children.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
It is important for the teacher candidate to see science as a social process--not as an isolated and esoteric activity. Science is not isolated from other areas of human endeavor and can be used to solve "real" problems.	Teacher candidates are challenged with problems which involve the personal concern of the candidate and which cut across traditional subject matter boundaries (i.e. science, mathematics, social studies, etc.)
Teacher candidates need to understand science as an inquiry process rather than a collection of facts and isolated concepts.	Teacher candidates are asked to work out strategies of inquiry for solving problems. The classroom questioning emphasizes diversity and what the candidate did rather than what answer he came up with.
Teacher candidates need to understand the cognitive and social characteristics of the students they are to teach.	Teacher candidates study the developmental psychology of Piaget. They use selected tasks to interview students of various ages and use that information to analyze their thinking processes. They also observe and interact with students in a classroom situation.
Teacher candidates need to understand that in order to meet the individual needs of their students they need to involve the students in the decision-making processes that affect them.	In examining the problems which make up a bulk of the course the candidates are put in the position of defining those problems, making up strategies for solving them, and evaluating the results.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The teacher candidate understands science as a social process involving "real" problems and which can be unified with other areas of the curriculum. The candidate emphasizes this with his students.	Observing the teacher candidate teaching science to students by using problems which involve mathematical and social studies principles as well as science, and which the students view as relevant.
The teacher candidate understands that the important part of science is its method rather than its product and consequently emphasizes this in his class.	When the teacher candidate teaches science, he allows students to make up their own strategies for solving problems. His questions in class are about method rather than results of the inquiry. He accepts diversity of results rather than fishing for specific answers.
The teacher candidate realizes that students have different learning and social characteristics. He also realizes that children's thinking processes are not necessarily the same as adults'.	The candidate provides students with materials to learn from which are compatible with the students' learning characteristics and which are flexible enough to be dealt with by different children.
The teacher candidate will understand the importance of decision-making as an outcome of education and its role as a strategy for teaching.	The candidate will allow his students to make up and solve problems as well as decide upon the procedures and the criteria of evaluation of results.

Running parallel to the preservice component, the inservice component has three phases: 1) the summer workshop, 2) inservice seminars, and 3) in class facilitation. The summer workshop is similar in intent and method to the preservice science/mathematics method course except that a social studies person, and an expert in learning characteristics, joins the science and mathematics specialists. This team of four works with selected potential directing teachers in innovative methods and materials for teaching elementary mathematics, science, and social studies; using communication skills; and examining the learning characteristics of children. The emphasis of the second phase - inservice seminars - is on the supervision skills needed to provide feedback to student teachers. Some time is also spent on helping and encouraging inservice teachers to open up their classes, use manipulative materials, and unify their science/mathematics program. The third phase - in class facilitation - is designed to help inservice teachers use these materials and methods in their classes. One member of the college team serves as a sort of science/mathematics supervisor. He visits classrooms, makes suggestions for activities, and sometimes helps teachers start activities. In summary, the inservice component is designed to lay the groundwork for student teaching and to help identify understanding and sympathetic classes for student teachers to work in.

The output of the inservice and preservice components is combined in the student teaching component. The student teaching component is supervised by two members of the inservice component staff along with the directing teacher. These two college supervisors have worked with the student teachers as well as with the directing teacher prior to student teaching. One supervisor is an expert in language arts and social studies while the other is an expert in science and mathematics. The student teachers and directing teachers are "matched" using criteria of dogmatism, rigidity, and personality factors measured by tests administered to both preservice and inservice teachers.

While the various parts of the teacher education program described above are certainly not new, we feel that the combination of experiences offered to our students, both preservice and inservice, has real possibilities.

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*(Unified Science and Mathematics for Elementary Schools)

AVAILABLE MATERIALS: (Not listed)

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Buies Creek, North Carolina

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PROGRAM DESCRIPTION (Preservice):

Todays college graduates, who select elementary school teaching as a profession, are confronted by a number of challenges generating from two current movements or trends in elementary school teaching: one, the movement towards increased acceptance of the federally funded elementary curriculum projects; for example, those proposed by such groups as the American Association for the Advancement of Science, The Elementary Science Study, and The Science Curriculum Improvement Study; two, the trend toward increased emphasis on environmental education. Some of the challenges evolving from these two movements are as follows: (1) Learning science through science processes as well as science fact; (2) student centered investigation into the realm of science; (3) development of new courses and programs in environmental science and in some cases an entire K-12 environmental curriculum; (4) a more field-centered or out-of-doors approach to the biological sciences; (5) modifying methods of student evaluation with a focus on de-emphasizing grades as a major instrument of motivation.

With the above challenges in mind, Basic Ecology for Elementary Education Majors was developed. Hopefully this unique departure from the more traditional type of biology instruction will enable the student to be better prepared to meet these challenges of modern elementary science teaching. The new approach is characterized by the following concepts: approaching our environmental crisis through an understanding of four major ecological principles (adaptation, change, diversity, interrelationship); utilizing a field-centered or out-of-doors approach to biology; obtaining course diversity through the use of contrasting field studies while maintaining course unity by emphasizing scientific processes; evaluating through the use of the scientific method of writing; teaching science through student-centered investigations. The six characteristics enumerated above comprise the conceptual scheme for the course Basic Ecology for Elementary Education Majors. Elaboration on each of these concepts is as follows:

Four major ecological principles. Four major ecological principles: adaptation, change, diversity, and interrelationships are fundamental to an understanding of our environmental crisis (Klimas, 1969). One of two methods may be used to expose the student to our environmental problems. First there is the block method. A four to five-week period consisting of lectures, slide programs, films and student panel discussions centering around the theme population, pollution, and politics. This crisis block seems to be more effective when presented at the end of the course, as opposed to the beginning, because the student has experienced weeks of ecological training and thus is more capable of absorbing and understanding the ecology of our environmental crisis.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Four major ecological principles are used as the focal point for all course content, process and methodology, (Diversity, Change. Adaptation, Interrelationships)	Field trips and field studies are designed to emphasize these four principles. By giving the student the opportunity to work out of doors, he is also given a change to discover living examples of these four principles in their natural environment.
Course diversity through contrasting field studies.	Each of the field studies involves the student in an investigation of very diverse habitats.
Course unity through scientific processes.	Prior to entering the field, the student is given a list of problem statements. He then observes, collects, analyzes data; draws conclusions in an attempt to answer problems.
Student-centered investigation.	Once in the field the student is free to investigate on his own. He decides what is to be observed, collected, analyzed, etc.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The potential elementary science teacher will recognize these four principles of ecology as the major components of all outdoor environmental study.	1. The student will be able to orally describe the field experiences relative to these four principles. 2. Given an oral list of statements pertaining to examples of how these principles exist in nature, the student will be able to identify the principles.
The potential teacher will recognize the fact that some field experiences are more interesting than others. Thus course diversity will enable a variety of experiences to occur and inturn meet individual interest more efficiently.	During the oral exam, the student will be able to list at least three reasons for his liking a particular field study.
The potential teacher recognizes that scientific processes are the same for all field studies. Regardless of their diversity, each study involves; observing, collecting and analyzing data, etc.	The students will be able to write up their field reports using the scientific method of writing. A behavior that requires an understanding of scientific processes.
Students, when investigating on their own, often time discover things not included in a teacher's course outline.	The student will be able to describe any "un-planned-for" experience that happened to him during his field studies.

The second method could be termed the integrated method. While still in an experimental stage, this approach will attempt to correlate specific environmental problems to a specific field study. For example, field study-I involves the aquatic ecosystem and accompanying the study will be a set of lectures, panel discussions, films, etc. on the ecology of water pollution. All environmental problems are analyzed in such a way as to dramatize the four major ecological principles mentioned above.

A field centered approach. Use of the indoor laboratory has nearly been abandoned. Equipment, as well as students, has been packaged to function where the action is; out-of-doors. The four major ecological principles mentioned above come to life in the form of well-structured field studies. Preparation is the key word at this point. Before entering the field, the student is first prepared through the use of a specially constructed visual aid instrument (a 2.2 color slide program) that demonstrates the field methodology to be used for a particular study. Ideally, three major field studies, each lasting approximately three weeks, will comprise the core of the course; a study contains two or three field trips lasting approximately 3 to 4 hours each depending on the nature of the study. The field trips utilize local surrounding environments thus providing easy access and more efficient use of time. Each study is characterized by contrasting habitats in order to accent the four ecological concepts. For example, field study-I, A Comparative Analysis of Two Fresh Water Ecosystems, contrasts the interrelationships, adaptations, diversity, and change operating in a pond to that of a stream.

Course diversity through contrasting field studies. Each major field study is different; for example, field study-II is An Analysis of North and South Facing Slopes in a Deciduous Forest and thus takes the student into a new and very different environment. Course diversity of this nature is extremely important for the student simply because students are diverse in aptitude as well as interest. Interest, enthusiasm and achievement may run high for some students when operating in field study-I, the aquatic ecosystem; however, other students may find the pathway to ecological understanding much more accessible when confronted with field study-II, the terrestrial ecosystem. The concept of course diversity thus offers many new and exciting environments for the student throughout the entire course as opposed to spending the entire semester in just one habitat.

Course unity through scientific processes. The field studies cited above, though strikingly different to the student, are approached through emphasis on the scientific processes to learning. The student is challenged by a list of problem statements relevant to the study in question; he then goes into the field where he observes, collects, and analyzes data in an attempt to draw conclusions necessary to support a hypothesis. This procedure characterizes all major field studies enabling a thread of unity to run throughout the entire course. Since science processes (the behavioral patterns of scientists) act as the common denominator for many types of science and discovery, they are emphasized more than science fact. However, the student is equipped with a portable field library containing books relevant to the study in question. The text and references vary in difficulty thus challenging the slow as well as the fast learner. The students use the field library to obtain only those facts relevant to the problem statement contained within the study.

The scientific method of writing as an evaluation instrument. The student is required to write up the field studies using the scientific method of writing. The method focuses on five main steps: problem statement, hypothesis, review of literature, analysis of data and conclusion. After operating in the framework of scientific processes and field discovery, this task becomes quite feasible for nearly all students. Evaluation consists of oral presentation and defense of the field report on a one-to-one student-teacher basis. Together, student and teacher determine what grade should be assigned to the study. The student is encouraged to center the defense of his field report around the four major ecological concepts mentioned above. At least fifty percent of the student's grade is determined in this manner. The student does the work; therefore the student has earned the right to determine what grade should be assigned to the study.

Student-centered investigations. Upon arrival at the field site, the students are divided into teams and assigned a field station. Each station is equipped with all the materials necessary for investigating the immediate environment. From this point, the student makes all the decisions as to what he will observe, record, and analyze. The course instructor is considered a part of the student library and present only to guide the student, when necessary, into a more productive line of discovery. This new approach, which the author calls student participation in learning, produces encouraging results; not the least of which is a student who begins to think, reason, and wonder about the complexity of his environment.

Summary. The author believes there is a need for preparing our future elementary school teachers to meet the challenges of modern elementary science teaching. With an ever increasing emphasis on the discovery method to learning science and environmental education, this needed preparation can be facilitated by exposing the future teacher to a new biology while still in college. New courses, specifically designed to meet the needs of these students, must replace the more traditional indoor laboratory and scientific fact centered approaches to science. Basic Ecology for Elementary Education Majors was developed to achieve this goal.

The conceptual scheme for the course is suggested as a framework for life science courses in junior high school and high school levels. The only modification necessary would occur in the nature of the field studies because of the variability in immediate out-of-doors enviroments.

Klimas, John. "Ecology, Why You Must Teach It." Grade Teacher Magazine, 1969,86(5).

AVAILABLE MATERIALS:

Course outlines are available for the fall and spring semesters. (Course mechanics are greatly influenced by season of year.) FREE

Four different Field Studies are available.

1) Aquatic: Comparative Analysis of Pond vs. Stream.

2) Terrestrial: Analysis of North-South Facing Slopes in a Deciduous Forest.

3) Old Field Succession in the Piedmont of North Carolina.

4) Comparative Analysis of Soil Types in the Piedmont of North Carolina.

Approximately 25¢ to 50¢ per copy to cover duplication and postage.

Copies of actual student reports, written in scientific method of writing, available for all four field studies mentioned above. Approximately 75¢ to $1.00 per copy depending on number of pages.

Slide Programs designed to prepare the students for the field studies (depicting equipment, field methodology, etc.), have been developed for field studies #1; #2; #3. Cost of Duplication approximately 35¢ per slide.

For materials write to: Mr. Peter A. Wish
Instructor of Natural Science
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UNIVERSITY OF SOUTH FLORIDA
Tampa, Florida

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COURSE DESCRIPTION (Preservice):

"Science for the Child," an elementary science education course at the University of South Florida, is based on five major criteria:

1. It is taught differently than any other courses that elementary education majors may have taken at this University. This approach was used to break the pattern of instruction typically offered in the University, hopefully stimulating the elementary education majors into examining alternative or innovative teaching techniques, including:
   a. performance-based instruction
   b. individualized, self-paced instruction
   c. modularized instruction

2. It is constantly modified as a result of intensive feedback from the participating students. Few modules used in the course have been immune from significant revision.

3. It is presented through the use of multi-media facilities and includes a significant proportion of manipulative activities such as we would like to find in the elementary science classroom.

4. Grading is specifically related to performance objectives given to the students. The student knows specifically what behaviors he must demonstrate and to what degree he must succeed in order to obtain a grade he elects to work toward. This specificity has resulted in a clear understanding of course requirements and aids in student selection of appropriate alternatives he may choose.

5. There is a serious attempt to bring generic teaching skills and knowledge into a close relationship to specific skills and knowledge required in teaching science to elementary children. Since our staff feels that there is a close relationship between these two areas, many performance objectives from generalized education courses are combined with science teaching objectives in this program.

These criteria are implemented through a series of thirteen modules or learning packets. Each module is useful in developing competencies in a specific topic of science education considered important for elementary school teachers. The modules provide the student with a plan of attack on the objectives of the course. In order to do this, each module contains:

a. a "flowchart" which helps guide the student through a sequence of activities.
b. an introduction which includes a rationale for the topics covered in the module as well as a list of performance objectives for the module.
c. study guides (in some modules) to focus attention on salient points during reading or other learning activities.
d. pretests (in most modules) which allow the student to omit certain activities if they can demonstrate that they can perform the objectives before entering the module.

The set of modules is presented to each student at the beginning of the course. During an introductory seminar the general philosophy and operating procedure of the course is explained by the professor. The students are advised to begin their work with the "Introduction Module." This module provides them with more information about certain unique aspects of the course as well as giving them the chance to plan a tentative scope, order, and time schedule for the work they will be performing for the course. Once the "Introduction Module" is completed, the students are ready to begin working on the substantive part of the course.

The modules and general goals of the course are listed in Table I. Specific behavioral objectives related to each goal are omitted due to lack of space. The number of objectives related to each goal is, however, included in columns three and four. The course objectives are divided into two categories - required and optional. The student's grade in the course is determined by the number of objectives he attains.

TABLE I. Modules, Goals and Objectives

MODULE	GOAL MODULE IS DESIGNED TO ENABLE TO STUDY	REQUIRED BEHAVIORAL OBJECTIVES	OPTIONAL BEHAVIORAL OBJECTIVES
Introduction	understand unique aspect of the course	1	0
Nature of Science	improve understanding of science	2	3
Primary Processes of Science	understand processes of classifying and measuring	3	0
Designing an Experiment	understand integrated processes and design and do an experiment	3	2
Planning for Teaching	write lesson plans which include performance objectives, discovery techniques and valid evaluation	3	0
Approaches to Teaching Science	understand several discovery techniques	7	2
	design and display a "Science Corner" project	5	0
Piaget in Science	understand mental development and capabilities of children	1	0
	administer Piaget tasks and analyze	1	2
Periodicals for Teachers of Science	understand characteristics of five journals	1	0
	describe five ideas for the classroom.	1	0
	examine resource materials available to science teachers and gather classroom ideas		
Curriculum Projects	understand trends in science teaching and characteristics of new science curricula	2	2
Teaching	teach and analyze science lessons which include discovery teuhniques	5	0
Recent Issues in Science Teaching	gain insight into topics of concern among science educators	0	1
Ecology and the Environment	understand ecological principles and plan and teach lessons which emphasize the environment	0	2
Your Thing	select any topic or project to improve science teaching	0	1

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PROGRAM DESCRIPTION (Preservice):

Competency Based Teacher Education (CBTE) has been hailed as a means of remedying many of the ills of teacher training. Although many educators acknowledge the merits of the concept, they are overwhelmed at the difficulty of transforming it into reality. A frequent cry is, "How can self-paced proficiency modules work in an institution built on schedules, credits, grades, and grade point averages?" Because such a problem exists at the University of Georgia most progress to date in CBTE has been within single courses. Although metamorphosis is incomplete, present and new programs in Elementary Science are significant steps toward a competency based program.

Modular instruction and field experiences have been combined since Fall Quarter, 1970. Elementary Science Methods has been one of three methods courses taken in conjunction with Principles and Practices of Elementary Teaching, a senior level field experience where students do supervised teaching in Portal Schools. Portal Schools are local public schools in which prospective teachers gain the practical experience needed to develop and refine specific competency requirements. Schools render _life_ situations not "life-like" simulation, so that students are able to function at the operational level rather than being limited totally to the theoretical level. Thus, Portal Schools serve as an application of the principle of appropriate practice. University and school staffs work together in a cooperative enterprise toward the meshing of the theoretical fundamentals with practical experience. Portal Schools are characterized by creative practice, integrated approaches and competency-based personalized instruction. Generally, Portal Schools are more direct and comprehensive than traditional lab or demonstration schools.

The methods courses have a dual responsibility: they provide raw material, ideas and techniques, for use in the field experience; and they have the more important task of helping students develop a philosophy of teaching and a repertoire of techniques which extend beyond the field experience. Science Methods is directed toward approaching science as a process as well as a body of knowledge. Students learn to structure activities which are within the limitations of elementary children. They view science processes as both tools and goals of instruction. As students use and compare current curricular materials and strategies they are encouraged to formulate a philosophy of science teaching. Developing the non-central, yet guiding, teaching style consistent with modern curricula is difficult for students who must first be convinced that significant learning can occur without the dominance of a teacher. The modular structure of Science Methods allows college students to experience the same environment advocated for children.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Idea--Silence and non-verbal cues can be combined to augment or replace verbal activity in classroom interaction.	1. Intern reads or views slide/tape description of specific techniques to use to aid communication. 2. Intern is given a "focus assignment" to provide direction to teaching. 3. Intern teaches lesson attempting to incorporate a variety of techniques. 4. Internuses focus and analysis sheets to assess effectiveness of instructional techniques. 5. Intern may attempt another focus session.

→ OUTCOME(S) ⇄ EVIDENCE

From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The intern is able to manage classroom interaction without verbally interjecting himself into discussion.	During a small group teaching experience the intern uses cues and/or silence to cause children to enter discussion continue in comments re-evaluate a statement momentarily stop discussion

The first modular learning units were derived from clusters of objectives used in a conventional methods program. Subsequent development has led to replacement or modification of nearly all objectives. A different set of modules is used with students interested in primary and middle grades. Modules are depicted on hierarchy-like charts which describe sequences in which the modules may be completed. Each module is outlined in detail on a flow chart and prospectus which describes the objectives as well as the entry requirements for the particular module. The flow chart also suggests a series of activities which should help students master the objectives. Although initial efforts involved establishing one activity for each objective, development has progressed so that many modules now contain alternate activities.

During a typical day students can be found working on many different modules. Although options within modules are somewhat limited, a wide variety of techniques is used throughout the program. Students may be in seminar or discussion sessions, viewing video-tapes or slides, reading, doing an activity from a curriculum project or preparing materials for use in the school. Students are invited to seek their own alternate procedures using all available resources.

The instructor in this course is free to interact with students to a greater extent than is possible in more conventional programs because much of his information sharing function has been absorbed by media-techniques. Students benefit from his saving when they are able to have small group seminars and individual conferences in lieu of large group instruction. More significantly,the variety of activity facilitates spontaneous discussion. Confident that assistance will be offered willingly, students learn to seek out the instructor or classmates when help is needed. Equally important, they learn that they are not forced to sit and listen should they be able to progress alone. Small group interaction is one of the strengths of the program. Whereas many self-paced or "modularized" programs are, or become, sterile because students have little contact with others, discussion and interaction are encouraged. Small group cooperation is effected by suggesting that activities be shared and then compared and by including discussion questions so that ideas can be nurtured. Students report that they come to know the instructor better than in most other courses and that they come to know each other better, too. Students fail to realize the extent of other more subtle growth. Cooperation and interdependence increases tremendously after a few weeks. While skepticism is prominent early each quarter, it largely disappears by the time students are due to apply techniques in the schools.

Positive changes in attitude are desirable, of course, and may reflect the most significant learning that occurs in such an atmosphere. At present no effort has been made to formally evaluate the course in this respect. Evaluation throughout the program has been designed to measure the objectives of each module. Rather than a mid-term and a final, each student has a series of "tests," each taken when he is ready. If the student feels "ready," after reading the objectives he may use the evaluation as a pretest in an effort to skip some or all of the activities. A student who does not elect to pretest, proceeds through the activities and then requests a post-evaluation. He is then given tasks which require written response or other performance. In the event performance is not adequate, the student is directed to additional activities to remedy the difficulty. If the problem is minor, the misunderstanding is cleared up on the spot and the student is free to continue. Thus, all students reach a standard level with respect to all objectives.

The achievement of course objectives showing an understanding of science and children is important, but not always sufficient to develop a good science teacher. All may be worth little when twenty to thirty children are introduced. The final modules involve a field experience, the component which focuses on the interaction between teacher and children and provides the opportunity to apply the techniques of science teaching. Unlike field experience elsewhere students in science methods courses at Georgia are given no specific lessons to teach. With the assistance of classroom teachers, they individually select appropriate lessons based on the specific circumstances encountered in the Portal School. Students are urged to attempt a variety of techniques. They attempt to evaluate their effectiveness based on the observed performance of their children. Both field coordinator and methods instructor are involved in observation and analysis of school activity. Free of traditional preparation and much tiring clerical routine, the instructor is placed in a creative role where he can respond with individual guidance and relevance.

The use of self-paced, science instructional modules facilitates the implementation of the Portal School concept by allowing flexibility of on-campus scheduling. Precise description of experiences in programs such as science allows staff to avoid overlapping material in various courses. Individualized pretesting provides the student additional opportunity to prevent unnecessary redundancy. On-campus instruction takes on more meaning as students are given an opportunity to extract relevant techniques, skills, and competencies for direct use in the concurrent field situation. Thus the student is provided with an effective framework for combining theory and practical experience. The goal in science is to have all students develop a similar set of general skills involved in teaching science.

The existing modular methods course and the accompanying field experience represent considerable progress over earlier programs. However, the pressure of time and schedule prohibit the repeated practice sometimes necessary before demonstrating competency. In response to the problem of block scheduling a trial program has been initiated so that University registration can be handled internally and formal courses replaced by modules, seminars and coordinated field experiences. Earlier experience with modules and field experience provided the foundation for the new program. Using modules and flexible scheduling of seminars have allowed increased time with children and provided sufficient time to demonstrate a satisfactory performance.

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*This description has been adapted from "A Modular Methods Course in Conjunction with Portal Schools," Science Education, in press.

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PROGRAM DESCRIPTION (Preservice):

This project has been developing an innovative program to train prospective elementary school teachers to teach mathematics. This program has two components: a teacher training component and a model school component. The teacher training program integrates the mathematics content and the methods for relating this content to elementary school instruction. The model school component involves the development of a mathematics program in a local elementary school where prospective teachers are able to observe good mathematics instruction and to practice teaching mathematics to children.

The instructional materials consist of units in which the mathematics content, related elementary school instances of that content, and methods for teaching such content are intermeshed. The materials provide sequenced activities through which prospective teachers may learn mathematics by doing it. The instruction takes place in a laboratory setting which has problem solving and the relationship between mathematics and the real world as its focus. Incorporated in the program are classroom visits in which the prospective teacher observes and has the opportunity to teach elementary school children.

Actual implementation of the Mathematics-Methods Program began in September 1972 with two pilot classes of approximately 25 students each. In both semesters the mathematics and methods are presented to the prospective teachers in an integrated fashion, by means of the units described above. Each pilot class is being team-taught by a graduate student (teaching assistant) in the Mathematics Department and a Mathematics Education faculty member. The classes meet three times a week for a double class period (one hour and 45 minutes) and on a fourth day visit the model elementary school.

At the model school, the prospective teachers work with small groups of children in follow-ups to the mathematics lessons, work with pupils on remedial or enrichment activities in the mathematics laboratory set up by the project at the model elementary school, and have been helping the children prepare for a mathematics fair. The mathematics laboratory in the school is directed by a mathematics resource teacher on the project staff, who coordinates the visits of the prospective teachers and whose assistance is available to the in-service teachers at the elementary school.

The goal of the project is to prepare all prospective elementary school teachers at Indiana University (approximately 600 per annum) through this program and to disseminate the materials and techniques of the project to other institutions.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
I. Mathematics should be related to the learner's real world. The teacher candidate has three "real worlds": one in the adult real world, another in the elementary classroom, and a third in the real world of the elementary school child.	In the teacher preparation program, the mathematics content, the related elementary school learnings, and the methods for teaching such content are completely intermeshed. The teacher candidate researches content occurrences in elementary texts, diagnoses child errors and proposes remedial activities, solves content sequencing problems, and devises activities to teach content to children. She is also confronted by open-ended problem solving situations which provide opportunities to apply mathematics.
II. The teacher candidate should be taught as much as possible as she should teach.	The mathematics is taught in a laboratory setting, through which the candidate learns mathematics by doing it and becomes familiar with many of the concrete materials which might be found in the elementary classroom.
III. Teacher candidates should be given opportunity to observe mathematics being well taught to children and to compare their teaching performance with that of the model teachers.	The teacher candidates travel once a week to a model elementary school.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The teacher candidate will have learned the mathematics necessary for adult life (content achievement)	Log of activities with children at model elementary school.
She will have the background to relate mathematics to the child's real world.	Performance on content test.
She will have the skills and techniques for teaching content to children; e.g., skill in content sequencing, skill in diagnosis and remediation.	Journal reflecting solution of mathematical and pedagogical problems. Responses on written tests to questions which pose problem teaching situations.
The teacher candidate has experience and confidence with teaching techniques and materials appropriate for the elementary classroom.	Log of activities with children at model elementary school. Practice teaching performance. Responses on written tests to questions which pose problem teaching situations.
The candidate has developed a larger repertoire of mathematics content and greater flexibility in presenting this content to elementary school children.	
The teacher candidate has developed confidence in her ability to teach mathematics to children.	Log of activities with children at model elementary school.

AVAILABLE MATERIALS:

Sample instructional units on specific mathematical topics are available on a limited basis.

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PROGRAM DESCRIPTION (One module in a preservice program):

The variety of science methods texts for preservice elementary and secondary teachers may consist of techniques or skills the text authors have used successfully in the science or science methods classroom. Although each author may view his collection of experiences and techniques as the most important, few methods teachers would probably agree. The result is that science methods teachers may use parts of several texts or add unique product developments. An alternative to the use of multiple texts would be to use learning modules each developing a single type of skill such as question asking, contingency management, mastery learning, or performance objectives. Learning modules could be developed using a variety of instructional techniques ranging from programmed instruction to several audio-visual techniques.

A question asking module for preservice and inservice elementary teachers is used here to illustrate the structure and function of a learning module. The module contains precise objectives which allow the learner to know what he can expect to learn. Examples of question levels or sequencing were followed by immediate feedback using self-tests with answers available to check accuracy of responses.

This module has five component parts: (1) The rationale to Question Asking, a review of Bloom's Taxonomy, and practice exercises in identifying each level of question, using Bloom's Taxonomy, from both written and audio-taped classroom dialogues, (2) practice in writing questions at each level of the Taxonomy, (3) practice in sequencing of questions using the Taxonomy, (4) practice in observing and recording the level and sequence of questions from audio-taped classroom dialogues, and (5) practice in identifying, writing, and coding the levels and sequencing of questions asked from audio-taped elementary classroom discussions.

The learning program for each of the five sections of the module is self-paced, but should require approximately three hours to complete. When the learner is asked to identify, write, or code levels or sequences of the Taxonomy, feedback is always provided with appropriate review for inadequate responses by the learner.

A carefully designed learning module could be used in a science methods course to not only develop specific classroom skills, but also to demonstrate a specific instructional technique such as programmed instruction.

Since universities vary in educational offerings and emphasis of educational practices, a science methods course constructed of learning modules may provide the flexibility needed.

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Learning modules are adaptable to a variety of preservice and inservice teacher training programs. Both preservice and inservice teachers using the question asking module can be trained to use question asking skills to promote more effective instruction. The module supplies the rationale behind effective question asking. It shows the learner how to identify and write questions at each level of Bloom's Taxonomy, as well as to identify effective and ineffective question sequences, and to write effective question asking sequences.	Written and taped dialogues between teachers and students provide the learner with experiences which when used with a self-paced program enable the learner to master the writing of questions at each level of Bloom's Taxonomy and the sequencing of these questions. Immediate feedback is provided with remedial exercises for inadequate responses.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The learner can identify and develop questions at each level of Bloom's Taxonomy. 2. The learner can identify proper and improper question sequences and can develop a proper question sequence using Bloom's Taxonomy. 3. The learner can identify and code the level of questions in a classroom discussion or an audiotape of a classroom discussion.	While listening to an audiotape of an elementary classroom discussion the learner: (1) will identify the level of questioning by means of the teacher question and the student response, (2) will identify properly and improperly sequenced questions based upon the questions characteristics and the student response. Preservice teachers use question asking skills in a videotaped microteach lesson, using peers or pupils as subjects, which are evaluated by the learner. Inservice teachers will use audiotapes of their classroom pupils for a self-evaluation.

AVAILABLE MATERIALS:

Question Asking Module, Okey, James R. and Humphreys, Donald W., Indiana University.

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JERSEY CITY STATE COLLEGE
Jersey City, New Jersey

Mitchell E. Batoff
Jersey City State College
Jersey City, New Jersey 07305

PROGRAM DESCRIPTION (Preservice):

Methods and Materials for Teaching Elementary School Science (2 s.h.). This is one component of a larger block designated as Curriculum Laboratory III (7 s.h.) taught prior to or concurrent with the apprentice teaching experience (8 s.h.). The total professional semester counts as 15 s.h. and is taken during the Fall or Spring Semester of the senior year.

AVAILABLE MATERIALS:

A List of Available Publications, Working Papers, Formal Reports and Non-Print Media on Various Aspects of The Unit Box Approach, 1969-1973.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
An understanding of the value and use of concrete manipulative materials for investigating physical and biological phenomena in the teaching and learning of elementary school science. An understanding of the value of concrete manipulative experiences as a pre-requisite for concept formation; and concomitant to skill acquisition and development of desired attitudes toward science and learning. An understanding that learning is essentially an active process and is best motivated by the learner himself. An understanding of meaning as an outcome of physical, emotional, and intellectual experiences; active involvement in the process, participation by the learner are prerequisites for meaning, for concept formation. An understanding that concept formation begins with experiences of many types, and specifically, with the free exploration of concrete material objects. An understanding that concept formation is fostered by exploring interactions, finding what changes or does not change as materials are related in various ways.	Teacher candidates interact with materials and with each other during each class-laboratory session of the methods course. These interactions of and between materials, students, and professor enables the professor to teach apprentice teachers by example rather than (or in addition to) precept. Several teaching-learning models are provided in the class-laboratory sessions. Piaget and Vygotsky's findings might be used to provide a rationale for the teaching strategy employed. The strategies used during each classroom-laboratory session of the course are tightly coupled to the major assignment of the course (done outside of class) viz., The Unit Box. Each teacher candidate assembles a materials-centered, multimedia Unit Box, the completion of which enables the apprentice teacher to employ similar strategies to bring about intended outcomes in his or her own classroom, both in the student teaching experience and thereafter. The teacher candidate uses his or her Unit Box in the classroom with children under the supervision of the methods course professor. This takes place over a six to thirteen week period during the apprentice teaching experience.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The teacher candidate begins to learn about the role of concrete manipulative materials in the teaching and learning of elementary school science. The teacher candidate begins to appreciate the role of concrete manipulative materials for intrinsic motivation in learning.	1. The teacher candidate prepares a Unit Box that provides the where-withal to implement what he or she has learned about the value of concrete materials in teaching and learning. The thoroughness of the teacher candidate's work, as exhibited in his or her Unit Box, gives some indication of the value the candidate places on materials for teaching and learning.
2. The teacher candidate learns ways to provide and effectively use materials in the teaching and learning of elementary school science.	2. Upon visiting the teacher candidate in the classroom during the apprentice teaching experience, the professor observes the candidate using the materials component of his or her Unit Box. The use of materials observed is along the lines of models provided in the methods course sessions or in other effective ways.
3. The candidate learns (is exposed to) a number of sample science units in which simple concrete manipulative materials are used in teaching and learning.	3. Conferences with the candidate's cooperating teacher and interactions with pupils further confirms or questions that which the professor observed during each of several classroom visits. (re: No. 2 above.)

JERSEY CITY STATE COLLEGE
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PROGRAM DESCRIPTION (In-Service):

Through first hand experiences, students will explore in depth and critically appraise the three major national curriculum projects in elementary school science: The Elementary Science Study (ESS), The Science Curriculum Improvement Study (SCIS), and The American Association for the Advancement of Science (AAAS) Program: Science --A Process Approach. These projects, funded by the National Science Foundation, are exerting a noteworthy influence on education around the nation and around the world. Some attention will be given to three other curriculum projects supported by NSF and U.S. Office of Education funds: The Minnesota Mathematics and Science Teaching Project (MINNEMAST), The Inquiry Development Program (IDP), The Conceptually Oriented Program in Elementary Science (COPES); and to one program developed under the aegis of private enterprise: Experiences in Science. The goals, accomplishments, expectations and future prospects of these large scale seminal efforts, should be of interest to pre-service and experienced teachers. Administrators, curriculum developers and school board members will find the course to be a valuable source of current information and a useful guide to intelligent decision making.

AVAILABLE MATERIALS:

Booklet titled "A New Course Offered By The Department of Elementary Education at Jersey City State College: New Developments in Elementary School Science: The National Curriculum Projects."

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
An understanding of a new emphasis on learning rather than teaching per se. An understanding that the responsibility for learning has shifted from the teacher to the learner; the role of the teacher has changed from a giver of all knowledge to a facilitator, learning strategist and guide.	Class sessions of the graduate course are conducted in a manner to illustrate these ideas through example rather than (primarily) by precept. The professor exhibits this changed role, placing greater emphasis and greater responsibility on the learner. He does it, far more than talking about it.
Modular units in elementary school science are numerous and varied. There are over 1000 modular Teacher's Guides available from no fewer than 150 sources. Among the origins are notable and national large-scale curriculum projects, small group efforts, as well as the work of informal, experienced, and creative individuals in the United States, Canada, England, Wales, Scotland, Australia, and parts of Africa.	Participants in the graduate course are exposed to 20 selected programs and projects in elementary school science produced in 7 countries. About 6 of these are treated in some detail and the others to a lesser extent. Participants are made aware of what is available and discern common features, virtues, and limitations of the various units and programs.
Change for its own sake is not necessarily good but developments of the past decade in elementary school science have something worthwhile to offer to most elementary school teachers; some change in this regard is probably very desirable.	

→ OUTCOME(S) ⇌	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Participants' classroom behavior is changed--perhaps a little. Participants try some of the units in their own classroom which they were exposed to in the course (or introduce some of these units into a school curriculum) Participants exercise leadership in their schools or districts to bring about desired and desirable changes.	Upon visiting the teacher in his or her own classroom, the professor observes an emphasis upon learning rather than teaching; the professor observes units being used which the teacher was exposed to in the course. The professor may, in some cases, see evidence of large-scale changes which resulted from the course (e.g., the introduction of a new program). Interviews with the teacher or consultant who took the course sheds further light on the attainment of said outcomes. Interactions with pupils in the participant's classroom and conferences with the participant's superiors, further expands on the evidence obtained as indicated above.

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PROGRAM DESCRIPTION (Preservice, In-service):

The major objectives are:

1. To identify the factors most influential in predicting student success in an audio-tutorial Physical Science course.
2. To identify the interrelationships present among variables.
3. To describe some of the characteristics of more successful learners.

The variables to be included are:

1. Attitude towards the method of instruction and the course itself.
2. Time spent per week on course materials -- All students are allowed to work at their own pace. No classes are scheduled. This course is entirely laboratory centered and amount of time the student spends in attendance is his decision.
3. Rating of units by student -- Sixteen units are presently available. Most students can select which units they wish to do with as well as the sequence in which they are done. Student grading is in part determined by the number of units that they complete.
4. Cognitive Style (Dependency-Independency).
5. Academic Aptitude.
6. Student Achievement -- as measured by academic average.
7. Critical Thinking Ability.
8. Course Achievement.
9. Science Achievement.

There is a definite need for more knowledge of the variables that affect learning in Audio-Tutorial (AT) courses. Analyses of methods used (audio-tutorial) and results obtained are necessary for further refinement of AT procedures.

The need for studying the variables involved in AT courses have been cited by many authors such as Sherrill and Druger (1971), Postlethwait et al. (1969, and many others. Novak (1970) states, "The relative research is small." A review of the literature suggests that the majority of the studies on the topic are comparison studies of "conventional" and"audio-tutorial" methods. These studies are comparing two different things, Novak (1970). There is enough research to indicate that no one method is consistently better than another in conveying knowledge. Saeteller (1968) points out that three-fourths of all comparison studies indicate no difference can be attributed to methods used. Formative evaluation is needed to allow better implementation of existing and developing methods of instruction.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Use of metric system for mass and volume	Audio-tutorial unit in which student performs six investigations of mass and volume
Use of concept of density	Audio-tutorial unit in which students learn relationship between volume, mass, boyancy and density
Use of concept that the state of matter is a determinant of an object's response to change	Audio-tutorial unit in which students investigate such phenomena as stretching wire, change of volumes of gases and liquids

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Complete competency of use of graduated cylinder, equal arm dial-o-gram balance	Students take a practical exam at close of this unit.
Ability to obtain densities of liquids, solids and gases to ± 2% of actual	Students take a practical exam at close of unit.
Complete competency to observe and measure appropriate constants such as elongation of a wire	Students take a practical exam at close of unit.

The population will consist of all non-science majors presently enrolled in Ed C 140 -- Studies in the Physical Sciences I at the University of Maine at Orono. The majority of the enrollees are elementary education majors, music and art majors. The following instruments will be used to collect data:

1. Watson-Glaser Critical Thinking Appraisal, form YM.
2. Cooperative Science Tests -- Advanced General Science Form B.
3. Laboratory Attitude Assessment Instrument developed by the authors (Butzow and Pare, 1972).
4. A cognitive style test modified from Atwood (1966).

A multiple regression equation will be used to determine influence of the various factors. A correlation matrix will be generated for intercorrelation. Factor Analysis and Cluster Analysis will be used to identify students with common characteristics.

Results of a pilot study indicate that students have a very strong positive attitude towards the method of instruction. Observations by the authors indicate that both dependency-independency and critical thinking may be important in predicting success. No further results are currently available. The study is presently under way and will be concluded in December, 1972.

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Novak, J. D. "Relevant Research on Audio-Tutorial Methods." School Science and Mathematics. LXX (9): pp. 777-784; 1970.

Postlethwait, S. N., J. Novak and H. T. Murray. The Audio-Tutorial Approach to Learning. Burgess Publishing Co., Minneapolis, 1969.

Saeteller, Paul. A History of Instructional Technology. McGraw-Hill Book Co., New York; p. 439, 1968.

Watson-Glaser Critical Thinking Appraisal, form YM. Harcourt, Brace and World, Inc., New York, 1964.

AVAILABLE MATERIALS:

16 AT units for physical science are available for use in our facilities. (We do not circulate our materials but do invite people to visit our facilities.)

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PROGRAM DESCRIPTION (In-service):

Five years ago, School District X was the first school system in the area to adopt the Science-A Process Approach program "across the board." During this time various problems developed: (1) teacher turn-over, (2) insufficient in-service training programs for new incoming teachers, (3) breakdown of S-APA equipment, and (4) the general decline of enthusiasm toward the S-APA program.

During the spring of 1972, I was asked to attend a meeting of the science committee. The science committee consisted of eleven teachers, one from each school in the district, and a principal. The purpose of the meeting was to clarify the problems many of the district's teachers were facing in using the S-APA program. It was quite apparent that changes were needed.

My major recommendation was to revise the standard S-APA Hierarchy Chart, eliminate some of the less necessary units, and develop a new School System X Science Sequence. In order to make this a cooperative endeavor rather than one suggested by an "outsider," a questionnaire was developed to survey the teachers' reaction to the existing program. Each teacher was given a list of all units taught in his or her grade level and was asked to designate whether or not the unit should be retained or eliminated and if there were any problems associated with equipment. The teachers were also requested to include their own suggestions for revising the existing program. (I also completed the survey and selected units which I considered most worthwhile.)

Three teachers from each grade level were selected to tabulate and discuss the results of the survey with me. We jointly established the following categories of units: core units and optional units for grades K-6 along with units for independent study in grades 5 and 6.

The next step was to consider and select units from other science curricula that would enrich some of the remaining S-APA units. During late spring, the entire package was discussed and approved by the initial science committee. The chart on page 63 summarizes the new science program.

During the early fall I met with all teachers from each grade level on separate days for 90 minutes. These meetings were held for the following purposes: (1) to present an overview of the new science program, (2) to provide opportunity for the teachers to "dry run" selected old and new units, (3) to establish the importance of key units in terms of skill building, and (4) to demonstrate ways of restructuring units for independent or small group participation rather than teacher-dominated presentations.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
To introduce students to the concept of process skills, specifically the skills of observing, using space-time relationships, measuring, classifying, communicating, predicting, inferring, formulating hypotheses, controlling variables, interpreting data, and defining operationally.	Eighteen stations with materials and activity cards are set up; there are one to three examples for each of the eleven process skills. The students are asked to complete at least one activity for each process skill. The activities are based mainly on ideas drawn from S-APA, SCIS, ESS, Science and Children. The questions presented are open ended.
To provide an opportunity for students to use ESS units and materials and utilize the messing about, multiply programmed, and discussion-generalization strategy.	Thirteen ESS units have been condensed into self-instructional "mini programs." The students are asked to complete three-four of the mini programs. (Group work is encouraged.)
Construction of one's own "mini unit" using task analysis for sequencing a minimum of five lessons.	Students analyze various instructional models, e.g., Gagné's, Taba's, Bloom's, and discuss the major components of sequencing instruction: selecting a terminal goal, hypothesizing entry behavior, constructing a tentative task analysis, constructing a pretest, administering pretest, modifying task analysis, and constructing performance objectives.

→ OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The student collects data for the eleven activities he selects to complete.	The student is able to operationally define each of the process skills within the context of the activity completed.
The student collects data for each "mini program" completed.	The student constructs materials and/or original activities to accompany each "mini program" completed.
Students develop a rationale and plan a strategy for sequencing instruction. The end product is their own "mini unit."	Students can demonstrate a relationship among activities rather than present isolated learning situations.

Grade	CORE PROGRAM	OPTIONAL UNITS	
K	PART A a,b,c,d,e,i,j,o,s,u,v (11) Watching and Wondering (Minnemast) Using Our Senses (Minnemast) Describing and Classifying (Minn.) Shapes, Sides, Curves & Corners (Stepping into Science, SID)	PART A f,g,k,l,m,n,q,r (8) Material Objects (SCIS)	
1	PART B a,b,d,e,g,i,m,n,s (9) Introducing Symmetry (Minnemast) How Big Is a Stick? (SIS) Food Is for Eating (SIS) Magnets (SIS) Primary Balancing (ESS)	PART B c,f,h,j,o,q,v,w (8)	
2	PART B l,p,u,y,z (5) Growing Seeds (ESS)	PART B x (1)	
	PART C a,b,d,i,j,l,n,t,v (9)	PART C e,r (2) Shadows and More Shadows (SIS) Shadows (ESS) Organisms (SCIS) Life Cycles (SCIS)	
3	PART C g,h,m,p,s,u (6) Animals and More Animals (SIS)	PART C f,w (2)	
	PART D a,b,e,q (4) Who, What and When (SIS) Things to do With Water (SIS)	Tangrams (ESS) Drops, Streams and Containers (ESS)	
4	PART D c,h,i,j,m,r,t (7)	PART D f,g,k,s (4)	
	PART E k,l,m (3) Rocks and Charts (ESS) Mystery Powders (ESS)		
		OPTIONAL	INDEPENDENT STUDY
5	PART E a,b,c,h,i,j,o,u,v (9) Batteries and Bulbs (ESS) Small Things (ESS)	PART E (4) e,f,g,n	PART E (4) d,p,q,r
6	PART E w (1) Peas and Particles (ESS)		
	PART F b,e,i,j,k,m,p,q,r (9) Pond Water and Cards (ESS) Brine Shrimp (ESS)	PART F (4) a,c,d,l	PART F (3) h,n,o

During the summer, several teachers were hired to restock supplies for the remaining S-APA units and distribute the new units and materials added to the program.

Many of the teachers expressed interest in developing individual or small group self-instructional packets or inquiry sheets. Teachers have been invited to attend grade level meetings, work in pairs for one hour on the units they intend to present in the near future. The remainder of the meeting will be spent in sharing and analyzing the ideas and strategies generated. The final products will be duplicated for the use of all teachers present and subsequently developmentally tested and revised accordingly. Implementation will be an on-going process.

University Course

The course, 151, Teaching Science in the Elementary School (University of Missouri-St. Louis), is lab-oriented and semi-individualized. The students may "contract" for the grade they wish to receive by successfully completing designated learning units.

The text used is Developing Teacher Competencies (ed. Weigand, Prentice-Hall, 1971).

Those students wishing to correlate field experiences with the science methods course may do so for one hour of credit. A description of the requirements for the Observation-Participation Course, 259, as well as the requirements for the science methods course may be obtained by writing Dr. Trojcak.

AVAILABLE MATERIALS:

Problem card directions to accompany process activities used in introductory module. (Cost - minimal - to cover duplication cost and postage.)

Mini programs (abbreviated versions in self-instructional format) of the following Elementary Science Study units: Primary Balancing, Pattern Blocks, Geo Blocks, Tangrams, Attribute Games, Brine Shrimp, Mirror Cards, Clay Boats, Mystery Powders, Rocks and Charts, Bones, Small Things, Peas and Particles, and Kitchen Physics. (Cost - to be determined)

UNIVERSITY OF PENNSYLVANIA
Philadelphia, Pennsylvania

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PROGRAM DESCRIPTION (Preservice):

The most unique and constant aspect of our course in the teaching of science in the elementary school is that it is subject to constant change. The same course is never taught the same exact way twice. The objectives remain the same, but the means of attaining them vary as the students and their needs and competencies. Thus in our own academic teaching, we practice what we preach to our preservice elementary school student teachers, namely that science in the elementary school should be material and student-centered.

The course given in the teaching of science in the elementary school to preservice teachers at the Graduate School of Education at the University of Pennsylvania is presented at both the undergraduate and graduate level to sections of no more than 24 students in a 32-hour, eight-week segment. The eight-week segment on campus is followed by a full-time field experience as student teachers in elementary school classrooms. The student teachers, both male and female, are academically qualified liberal arts majors in the University's ivy league colleges as well as candidates for the B.S. or M.S. in Elementary Education. This circumstance indicates that they have had to meet a natural science distributional requirement as regards to content in the sciences, and more than likely have had a substantial high school experience in one of the new curricula. These students have also had a substantial introduction to educational social foundations and psychology in their other preservice courses, so that when they approach this final education-block course, they are ripe and ready for methods and procedures to turn a wealth of theory into practice.

In making curricular decisions, and within the time contraints alloted us, we capitalize on this latter fact. Content considerations and scientific fact become secondary to objectives concerning the development of a positive affect for the teaching of science in the elementary school and the sharpening of process skill development. We are very much aware through research reports and personal field observations that science is the "stepchild" of the elementary school curriculum, relegated to 3:00 Friday afternoon, if ever, rather than early Monday morning. This observation is rampant wherever there is no prescribed national science curriculum or instigated supervision contingency. The situation is compounded where the classroom teacher himself/herself has never had a pleasant experience in science education.

Our primary aim, then, is to give our student teachers experiences that will make them sense the "joy" inherent in the manipulation of materials, in

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
The teacher candidate will develop a positive affect for the teaching of science in the elementary school as an integral part of the daily program and as a motivating discipline with regard to the more stable, quiet areas of the curriculum.	Teacher candidates observe the instructor's enthusiasm for the field; engage in activities especially chosen for their affective component; are not deluged with tremendous assignments, content-oriented; are allowed the freedom and the time to savor a whole sequence of different type activities.
Science is "doing," the manipulation of materials, throw out all classroom texts as part of the inclass program, use them only as after-the-fact enrichment tools or to satisfy the more able pupil's desire to get more knowledge on a classroom activity (after he has carefully thought it through and satisfactorily manipulated the materials in class).	The academic sessions are 90% doing, involvement sessions with appropriate materials, 10% discussion sessions including films, tapes, examining of related materials, new programs, etc. Content in elementary school science is secondary to the joy of it and process and cognitive skill development. Course prospectus recommends texts, nothing required.
Good science teaching means knowing what is available in the field of science curriculum and eclectically making individual curricular decisions to fit children and school needs and capabilities.	Teacher-candidates interact with AAAS, SCIS, ESS, IDP, etc. hardware and software materials; discussion of strengths and weaknesses of each approach; individual workshops in each; one activity = a mosaic of 2-3 of the programs.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The teacher-candidates become infected and affected with instructor's positive stande; 2. They imitate teaching tactics which show their enthusiasm; 3. They voluntarily take over the science-teaching component of their practicum.	1. Teacher-candidates seek help in proposing a curriculum for a 7-week practicum; 2. Instructor observes candidates teaching in the field; 3. Verbal expression of "It's fun!" .."Never thought so before!"
1. The teacher-candidates will teach exactly as they have been taught, employing similar materials, methods, and experiencing similar positive outcomes. One practices what he preaches, acts as he believes best, and evaluates results in terms of his own intellectual honesty, adding or detracting as is necessary to attain his goals.	1. The exact replication of an activity in the academic classroom in the candidate's practicum; 2. A verbal expression of accomplishment and desire to do more of the same.
1. Teacher-candidates will depend on own resources when confronted with a no-science approach school; 2. Will know where and how to pick and choose sequential, psychologically sound experiences for different ages of children.	1. Teacher-candidate devises own curricular design for a 3-sequence science curriculum at particular grade level; 2. Uses materials and methods of at least two recognized programs, plus own ideas from other resource books.

the discovery of "big ideas", and in the steps of learning how to think logically. There is never a lecture in this course. The many faces of inquiry are presented in directed and undirected lab exercises, demonstrations, group activities, films, and interactive discussions. The instructor teaches as she would have the student teachers teach their own children. The approach is then totally - "Do as I do!, not "as I say!"

Secondly, the realization that most of the nation's schools do not have the equipment supplied by the kits of the recognized programs necessitates an eclectic approach as to what is the very best available. The "joy" of science is illustrated through the most successful, representative exercises of the AAAS-SAPA, SCIS, ESS, EDP, and COPES programs. Critical discussions involve where to use what, when, how; and effective considerations for using programs in concert with one another, or adapting ideas that are cogent with available supplementary materials are also presented. With this very practical approach, we anticipate the very real-life situations that our student teachers will encounter in the field and give them concrete options for attacking such problems.

Thirdly, we ascribe to the Piagetian dictum that, "Penser, c'est operer!" To be a good teacher, one must teach; to be an effective teacher of children, one must teach children! Therefore, on two different occasions, neighborhood children are brought into the college classroom-laboratory for two different science learning experiences: a tutorial and a microteaching experience. In the former, each student teacher has one pupil to teach for a 10-15 segment. The children for this segment of the practicum are primary children. The student teacher prepares his/her lesson on a ditto so that feedback after the experience may be shared by classmates. In the microteaching experience, three student teachers share a group of four intermediate-grades children in a team-teaching situation in a format for evaluation and critique that is a function of each individual group after an entire group session in teaching behavior and interaction analysis. Dittos are again prepared by individual student teachers to be shared by colleagues and retained in a recommended, growing, perpetual science education teaching file. After each of these practical sessions, the student teachers witness the instructor teach the various groups of children, and are given the opportunity to evaluate her performance in the light of certain objectives. Videotaping is an important part of the critique aspect of this part of the course. In end-of-the-term course evaluation, this sequence in the interaction of student teachers with various-aged children receives the most positive response. As a third experience in this regard, the instructor personally visits the classroom of each of her student teachers on a prearranged, appointed day to observe an intact, total class lesson in science, which is part of the on-going curriculum of the respective grade or class. The student teacher then receives immediate feedback and, if necessary, constructive criticism with regard to teaching method, skills, content-level, etc. in an evaluation format that both instructor and preservice teacher have agreed upon and understand. (In many cases, if this visit were not part of the requirements of the course, there would be no science teaching on the part of our people-not of their volition, but of prevailing school policy, or in-service teacher apathy!) Besides attendance and participation in classroom on-the-spot activities and competencies, this three-sequenced observed practicum is the only required assignment of the course.

In a research study conducted during one semester, we statistically determined a significant change with regard to attitudes toward science, and in the knowledge of the processes of science, within the framework of the 32-hour sessions. These were both in a positive direction. The classroom on campus presents a relaxed atmosphere of affective and cognitive learning, and we feel that with constant flexibility of course design and recognition of the changing needs of our students always uppermost, we shall continue to meet and exceed our objectives!

POSTSCRIPT: The frightened English and Art majors of September and January make our most effective elementary school science teachers--come December and May!

Education 421, Fall 1972.

TOPICS

Introduction to Inquiry (AAAS.TPM Form A) in science teaching; methods: Exploration, Invention, Discovery - The Aquarium, The Terrium

Observing; classifying; inferring - Ecology: The "Quadrat"; IDP-Approach (Film, Discussion)

Measuring, using numbers, communicating, Basic Processes Workshop (content: Simple Machines) - Activities, Competency Measures

Elementary School Science: The Alphabet Programs Spectrum (SCIS, AAAS, ESS, IDP, ES, COPES) - (SCIS Workshop)

Bring Shoeboxes; Life Science Laboratory: Animal Behavior; Nutrition, Health and Sex Education: A Model for the Elementary School Classroom

Magnetism; Electricity; The Integrated Processes Workshop (AAAS Workshop) "Experimenting"

Astronomy; Space; Rocketry, Activities: Process, content (ESS-Approach)

Earth; Environmental Studies; Interdisciplinary science; ES-Sence Workshop Activities

Mungbeans; Learning Centers in "Experimenting" (Inconsistency and Discovery; A Learning Model)

(Primary Grades) Tutorial, Critique, Videotaping (1:1; 10-15 minutes)

Effective Science Teaching Techniques: Interaction Analysis; The art of asking questions; Evaluation (Behavioral objectives)

(Intermediate Grades) Microteaching, Critique, Videotaping - (1:4; each 15 minutes, 3-Teacher-Team approach)

Space-time operations, Motion; Force; Relativity; Distance; Symmetry-Activities

(AAAS.TPM Form B); Learning Centers in Science Education, The Field Trip

(Intact Class Observation by Appointment)

Fall, 1972
Education 421/521 Science in the Elementary School; University of Pennsylvania
Graduate School of Education

PURPOSE OF THE COURSE:

This course is designed to give the elementary school teacher a comprehensive overview of the objectives, concepts, processes, materials, and methods necessary to teach a modern course in science on the various levels in the elementary school. The course places primary emphasis on the student's teaching of science behavior in the elementary school classroom. This teaching behavior is evaluated with regard to four fundamental aspects of effective science teaching: (1) the development of a positive set of attitudes toward the teaching of science in the elementary school (2) the use of the processes of science, (3) the demonstration of a basic knowledge of pertinent science content and (4) the formation of the habit of continuous learning. Through individual experimentation, data-collecting and data-analyzing experiences, discussions, demonstrations, and field work, the student should acquire a positive attitude toward the scientific endeavor in society as well as in his own specialty and a workable understanding of the processes and content necessary to effectively teach science in the elementary school. These acquisitions are evaluated in the course of a practicum involving the student's teaching behaviors in three different types of classroom situations. Feedback and critique are an integral part of this aspect of the course.

COURSE REQUIREMENTS:

1. To perform the activities assigned during class periods; to complete at least two of five learning center investigation set-ups in the laboratory;
2. To demonstrate specific skills as an individual in the stated behavioral objectives for the competency measures distributed in class;
3. To begin the accumulation of a long term professional science education file which shall include initially:

   all classroom handouts
   procedure, data evaluations of all class activities
   notes on classroom discussions
   student teaching plans and dittos
   lesson evaluations and critiques
   notes on outside extraneous readings, sources of references
   experiments that work well and those that don't
   article clippings (magazines, newspapers, journals, etc.)
   children - ideas
   cooperating-teacher successes
   equipment inventory
   own discoveries, "aha" experiences, etc., etc.

4. To plan on ditto, and teach at least three science lessons to elementary school children: (1) a tutorial, (2) a microteaching session, and (3) an intact classroom. The tutorial and microteaching sessions will be taught during specific scheduled times in the science education laboratory at the University of Pennsylvania within the eight-week regular methods course. Children will be brought to the Graduate School of Education from the university-related schools. The tutorial will be an observed 1-to-1 teaching experience. The microteaching session will be a team-teaching effort. Student teachers will rotate in teaching, observing, and critiquing capacities while interacting with the same group of children. Videotaping will be used in evaluating these experiences where possible. The intact classroom will be taught at the individual student teacher's respective school and observed by the instructor. For each or any of the three teaching sessions, materials may be drawn from such elementary school science curricula as: SCIS, ESS, or S-APA, IDP, ES packets, or COPES.

COURSE READING: BOOKS AVAILABLE FOR PURCHASE IN BOOKSTORE

For detailed statement of course readings and course objectives, contact Dr. Rose.

PURDUE UNIVERSITY
Lafayette, Indiana

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PROGRAM DESCRIPTION (Preservice):

If we expect classroom teachers to individualize their instruction, then we must begin to individualize our college teaching methods to prepare prospective and practicing teachers for using these methods in the classroom. At Purdue University we have developed a graduate course in Individualized Instruction techniques and we are attempting to individualize our undergraduate science methods instruction. For as we find that each child enters a grade level with differing abilities, we also find that each undergraduate or graduate college student enters a course with differing abilities.

With an individualized approach, we are attempting to design a specific program of instruction for each student based on his background experiences, interests, and abilities. In order to implement this approach in a college course or school classroom, four instructional decisions must be made:

1) What are the students able to do before instruction begins?

2) What should the students be able to do after the instruction?

3) How are the students to acquire these competencies?

4) How will we know that the student is able to do what has been specified?

In order to make these instructional decisions, entering science methods students, for example, are presented with a pre-assessment drawn from twelve science skill areas which utilize a variety of science fields and are drawn from both the life and physical systems. An effort is made to make the pre-assessment activity orientated as is the college methods course. Skill areas such as: observing, measuring, inferring, using numbers, classifying, space/time relationships, communicating by graphs and predicting from graphs, performance objectives, formulating hypotheses, interpreting data, controlling variables, and defining operationally. These skills are common to the three major elementary science programs: Elementary Science Study, Science - A Process Approach, and Science Curriculum Improvement Study; thus, these skills will also be emphasized when our prospective teachers teach children. The pre-assessment measure enables the students to determine where they are with respect to the science methods instruction under consideration. Each student can then construct his own program of studies that will emphasize strengthening his weak areas and enriching his other skill areas.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Process skills of science	Students utilize 12 instructional modules relating to these skills on an individual or small group basis.
Interaction with children	Micro-teaching with children utilizing audiotapes and an interaction analysis working in teams of two.
Development of a positive attitude toward teaching science in the elementary school	Inquiry teaching strategy utilizing Postman-Weingartner's Characteristics of An Inquiry Teacher and Questioning Techniques.
Use of psychomotor skills in science	Techniques -- Mini-courses in working with glass, soldering, drilling, etc.
Development of a Teaching-Learning Science Center	Students construct a center with aid of a programmed handout.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Mastery of these 12 skills	90% on post-assessment
Ability to teach these science skills to children	Direct observation plus an analysis of the teaching process
A positive attitude toward teaching science in the elementary school	Pre-Post assessment positive gain in attitude profile as measured by our attitude test
Mastery of these skills	Examination of the finished product
Ability to construct and implement an interest center	An examination of the finished center based on previous criteria

Individual modules are being developed for student use in these twelve skill areas. Modules are being organized utilizing the following five-step format:

1) Performance objectives stated in behavioral terms

2) Pre-assessment evaluation

3) Materials needed

4) Instructional procedure

5) Generalizing experience or individual post assessment.

Performance objectives have been used since they enable the instructor to easily differentiate among the students. Most importantly, performance objectives can be used to serve as the basis for the preparation of all appraisals and to reveal the goals of the instruction to the students AT THE BEGINNING rather than at the end of the instruction. The pre-assessment evaluation can be used to determine whether or not a student should proceed through an entire module or through certain parts or should bypass it entirely. The instructional procedure states a method of attack to a problem as well as a rationale for the problem. Since science skills are activity orientated and can be applied to both living and non-living systems, the procedures are left open-ended as much as possible. The generalizing experience or individual post-assessment is utilized to illustrate that these science skills apply to many areas and fields of science. It is also used to find out if the student understands the goals of the module. At the conclusion of the course, a post-assessment is given so that students may compare their overall performance with their entering profile. Part of the course grade is based on mastery of the designated skills in relation to the student's entering profile. In addition, our graduate course has assisted over 150 teachers in elementary and junior high schools in the preparation of individualized instruction materials drawn from subject areas ranging from mathematics to language arts and reading to art and music. The class visits classrooms located throughout Indiana and Illinois to see individualized instruction in operation, learns individualized instruction techniques, and also analyzes commercial programs such as Individually Prescribed Instruction (IPI) and Project PLAN.

Purdue is one of the few colleges or universities in the nation that offers preparation in individualized instruction techniques, and inquiries about our unique approach have been received from teachers and college faculty members from throughout the nation and several foreign countries.

If we agree with the thesis that teachers and professors will teach as they have been taught, then we are on the right course of action. For as one student said, "I know what I have to do, so I just go on my own."

AVAILABLE MATERIALS:

Sampler of modules and course outline of individualized elementary science methods course. (Free)

COLLEGE OF SAINT TERESA
Winona, Minnesota

Oscar Horner
College of Saint Teresa
Winona, Minnesota 55987

PROGRAM DESCRIPTION (Preservice):

UPSTEP at the College of Saint Teresa has as its major goal the designing and implementation of a science curriculum for prospective elementary school teachers. Our purpose is not to form elementary school science specialists but to provide a college science experience for prospective generalists so that they will be able to teach science in the elementary school as it appears in the new science curricula, especially ESS, SAPA, and SCIS. Further, we wish to provide opportunities for the students to experience the liberating effect of science understood as a distinct mode of knowledge. We propose that our pre-service teachers, after completing the program, will be capable of implementing an activity-oriented instructional program for children that is humanized and relevant to modern society.

It is also our purpose, along with faculty from the UPSTEP project at Winona State College, to serve as resource personnel to the administrators and teachers in the Winona elementary schools. Through the efforts of the UPSTEP faculties, the work of UPSTEP students in the classrooms of the Winona Schools, and the cooperative utilization of the UPSTEP Resource Center at Winona State College, we hope to be a real aid to the schools over the next three years as they implement a new science curriculum for children.

Elementary education students in UPSTEP at the College of Saint Teresa are required to take three semester courses in Unified Science in three terms. Excellent cooperation and mutual respect between the biological science faculty and physical science faculty have made it possible to construct courses which are based on process and which cut across many scientific disciplines. No attempt has been made to establish a hierarchy in either process or content. The courses depend heavily on ESS, SAPA, and SCIS for content areas, process, and approach and are intended to be immediately relevant to the teaching of elementary school science.

The Unified Science courses are individualized or personalized, self-paced, and performance-based. Presently, at the beginning of each course, students receive packets of about 50 modules (MODs), 16 of which are required and 9 to 19 of which are elected. A few of the MODs involve large group activity (18-20 persons), some involve small group activity (5-6 persons), and most of them are designed for work by individuals or by pairs. Except for three reading MODs and four seminar MODs in Unified Science III, the MODs over three terms involve "hands-on-science" and a dealing with the real world, whether in the laboratory or out-of-doors. Unified Science II, offered in the spring term, provides an opportunity for the student to do at least two-thirds of her work outside - in nature study situations.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Pre-service elementary teachers who experience success in coursework exemplifying the processes and content contained in the new elementary science curricula will not only be capable of but will be desirous of teaching children according to the style of these curricula. Further, if they have "hands-on" science experiences and demonstrate proficiency in process skills they are likely to use these experiences and teach these skills to their pupils. Finally, favorable attitudes toward the teaching of science in the elementary classroom can be fostered in pre-service education which is self-paced, personalized and humane and which allows for student self-determination within the science curriculum.	Pre-service elementary science teachers take a sequence of science which is self-paced, personalized, modularized, which emphasizes process, and which is based on an inquiry, "hands-on" style of learning. Assessment is individualized and performance-based and is done on each of the student's selected 25-35 modules. Large portions of the coursework depend heavily on the three major elementary science curricula: ESS, SAPA, and SCIS. The third term of Unified Science contains seminars and activities based on current theories of learning (Piaget, Bruner), philosophies on teaching science, and teaching experiences in a local elementary school. Interaction and feedback concerning these lessons comes from (1) video tape, (2) college faculty member, (3) peer partner, and (4) children.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The pre-service teachers have shown the capability and the desire to teach science by an inquiry, "hands-on" approach, and they have expressed the needs children have to learn basic process skills. They have demonstrated their ability to foster pupil interaction and to use it as a method of facilitating inquiry-styled lessons in science. Further, they have shown competence in planning inquiry lessons from highly-structured, content-oriented science curricula.	Through onsite observation by the science faculty member and through description feedback from the cooperating inservice teachers and the college elementary education supervisor it has been determined that the student teachers are for the most part (roughly 80%) demonstrating the competencies stated under "outcomes". The Semantic Differential (instrument to detect attitude changes) and the AAAS Science Process Measure for Teachers (Form A) are currently being used to quantify some of the outcomes.

PROGRAM DESCRIPTION

Many of the MODs used in the three courses are adaptions of material in ESS, SAPA, SCIS, and other new curricula. Others have been designed by our UPSTEP faculty to reach into disciplines not emphasized by the new general curricula for children, e.g., earth science and astronomy. All of the MODs require further revision and improvement and will be ready to be shared with other institutions by the end of summer, 1975. In all, we hope to produce well over 100 MODs.

The students are evaluated usually individually, sometimes in pairs, by an UPSTEP faculty member. Except for the seminars and field trips and about half a dozen written assessments, the evaluations are oral and may last from ten to twenty minutes per MOD. If it seems that a student has not learned sufficiently by doing the MOD, he/she is not penalized but is asked to continue working until there is success. At this point in our program, we must give grades - A,B,C - and the grades given depend on the number of MODs satisfactorily completed. A few "Incompletes" have been given because of students' particular predicaments. Any student may attempt to test out of most of the MODs by an interview with one of the faculty members who decides whether or not the student has mastered the content and process involved (sometimes a written pre-assessment precedes the interview). Thus far, relatively very few students have taken this road.

Of the three Unified Science courses, the third one is the most professionalized. In addition to science content and process MODs, the students do readings and attend seminars that involve: Piagetian theory, the inquiry approach to teaching, and the histories, philosophies and products of ESS, SAPA, and SCIS. They teach both their peers and children in small-group sessions that are videotaped and then analyzed. All of this is designed to help our students formulate their own philosophies of teaching science and crystallize their own convictions regarding inquiry teaching. We feel that this course, in particular, should give our students not only the ability but the desire to teach science by an inquiry approach, and we are trusting that they will leave our program as leaders - not only potential but actual - in the implementation of new science curricula for children.

The UPSTEP faculty has made a conscious and concerted effort to produce a curriculum that is humanized, that increases the student's sense of self-worth and that forms in the student concern for others. We have tried to design activities in which students can succeed and thus overcome the fear of science that most of them have acquired over their school years. Deliberate steps are taken to promote a student's interaction with peers and with UPSTEP faculty. We have encouraged and have delighted in student criticisms and suggestions for improvement, and, on the basis of this type of student input, we have already introduced changes in the Unified Science courses. We enjoy this type of interdependency and will continue to promote it. Thus far, one student-constructed MOD has been incorporated into our curriculum. In December, 1972, we will choose several more, and, hopefully, this student input will continue as the program progresses.

The UPSTEP program at the College of Saint Teresa revolves around the central idea of forming teachers who can and will want to teach elementary school science within the philosophies of the new science curricula. In order to ascertain whether we are accomplishing this task several methods of evaluation are currently being attempted or proposed.

(1) We must measure certain student attitudes before and after the program as compared to similar students not in the program. The Osgood Sematic Differential is being employed as a partial means to this end. This "test" is administered before the beginning of the three-term sequence of Unified Science, at the termination of the sequence, and once again after the completion of student teaching. In this manner, we hope to detect attitude change concerning several aspects of teaching.

In addition to formal evaluation of attitudes towards teaching science, we have information in the form of descriptive feedback from teachers, school administrators, and associate college staff. In general, the UPSTEP student teachers not only feel competent to teach science but, more often than not, select science as the first subject they want to teach in their student teaching practicum. The student-teaching supervisor from our Education Department has indicated that not only are the UPSTEP students more competent than previous students in teaching science to children, but their total teaching picture has been affected positively by their preparation in our science program.

(2)We must observe the student as he/she moves through the science sequence and teaching experience in order to ascertain whether he/she understands and accepts the philosophies of the current elementary science curricula.

Our present program allows three opportunities for assessing the student in a teaching role before graduation. These include (a) peer teaching (videotaped), (b) a two-week teaching experience with children in a local elementary school (also videotaped and observed by a peer partner, a college faculty member, and the cooperating classroom teacher), and (c) student teaching for a full term (observed by a college science faculty member).

(3) We hope to determine whether Unified Science is developing process skills in the students themselves. Beginning with the third group of students (Winter, 1972), a process test will be administered in a pre-post design.

Since our program is linear, no one group of students has completed the entire science sequence and student-teaching experience, and any attempt to quantify results at this time would be premature. We hope to start seeing group results as early as spring semester, 1973 in at least one area of evaluation, i.e., the attitude measure mentioned in item #1 above.

AVAILABLE MATERIALS:

The College of Saint Teresa's UPSTEP Program is in the process of developing a battery of Module Exercises used by the students in the science courses required for Elementary Education. The modules, as they are being developed, are being tested and revised, over a four-year period. At this point the modules are not available for distribution. Interested persons can obtain sample copies by writing to the Director of the Program.

STATE UNIVERSITY OF NEW YORK AT BUFFALO
Buffalo, New York

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PROGRAM DESCRIPTION (In-service):

The following purposes of the in-service elementary school science program are used as guidelines to design the activities:

1. Facilitate teachers' comprehension of central science concepts
2. Provide models of science teaching strategies
3. Provide approaches to evaluating science concept learning.

The major role defined for the in-service teachers in this course is diagnosing and remediating science concept learning difficulties. The teachers are provided with materials from the Science Curriculum Improvement Study program, the Science-A Process Approach program, and the Elementary Science Study program. Central concepts in each of these programs are analyzed and evaluated in terms of the potential difficulties that pupils may have in acquiring them.

Videotapes of various teaching strategies using these curriculum programs are shown to the teachers. Competencies and performance strategies of the teaching models are analyzed and evaluated.

The teachers construct evaluation devices that they use with individual children in their classes. The evaluation instruments that are constructed use Piaget's developmental schema as a basis for diagnosing the types of problems that children have with the science concepts. The instruments utilize science concepts that are presented in the curriculum programs discussed in class.

The teachers also construct remedial activities and programs that are designed to correct problems that children have with the science concepts. The programs are tried out with children in their classes on an individual basis.

After completing the construction and evaluation of their programs and tests, the teachers are shown videotapes of children that have learning difficulties. The teachers are evaluated on their ability to diagnose the learning problems that the children have and their ability to prescribe corrective treatments to remedy the children's problems with the concepts.

AVAILABLE MATERIALS:

None listed.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
An understanding of the processes of concept formation and skill acquisition is necessary for a teacher candidate to learn to recognize and remedy children's learning problems in science.	Teacher candidates interact with young children and/or "slow learners" as they acquire key science concepts and skills. This interaction enables the professor to teach the candidates how to recognize, define, and prescribe remedial instructional strategies. Piaget's findings might be used to explain some learning difficulties, and examples from the early history of science can be used to show the development of these thinking patterns.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The candidate learns the role of remedial diagnostician. 2. The candidate learns to recognize situations in which it is appropriate to assume this role.	Upon viewing a film or videotape of someone teaching children with difficulties in concept learning or skill acquisition, the candidate: 1. identifies and states the clues showing the need for remedial diagnosis; and 2. proposes appropriate diagnostic and remedial strategies.

TEACHERS COLLEGE, COLUMBIA UNIVERSITY
New York City, New York

Willard J. Jacobson
Teachers College, Columbia University
New York City, New York

PROGRAM DESCRIPTION (Preservice, In-service):

Science In Childhood Education is a professional course in elementary school science. The purpose of the course is to help teachers, science consultants and supervisors, administrators, parents and others concerned with the elementary school develop and improve their work with children in science. A point of view for science in the elementary school is developed; new approaches to elementary science are explored; demonstrations of a wide variety of elementary science activities are presented; the construction of various kinds of simple equipment will be shown; and some of the professional problems that are encounted in elementary school science will be discussed.

Demonstrations, experiments, investigations, projects, cooperative investigations, field trips, and other approaches to teaching are used in the course. Laboratory work is an integral part of the course. Laboratory sessions are held at 3:00 p.m. or 7:30 p.m. on Thursdays.

AVAILABLE MATERIALS:

The New Elementary School Science. Van Nostrand Reinhold. (Especially sections on investigations and child development as related to science.) About $8.50, Van Nostrand Reinhold.

"Investigations in Science,"
Free from author.

Modern Elementary School Science. Teachers College Press. (Especially sections on criteria for evaluating programs.) About $3.00, Teachers College Press.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
To be able to undertake and carry out a science investigation such as they as teachers might have children do.	Undertake an elementary science investigation.
To be able to explain and teach a scientific idea.	Micro-teach a science lesson to two or more children. Tape record lesson. Listen to record of lesson and write a critique.
To be able to read, analyze, and criticize elementary science programs and materials.	Analyze and write a review of an elementary science program or of the materials available for use at a grade level.
To be able to analyze children's responses to a series of tasks in terms of Piagetan levels of intellectual development.	Present and tape record several Piagetan tasks to two or more children. Listen to tape and write analysis.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
To be able to carry out the investigation and write a "scientific" report.	A written "scientific" report and a demonstration to a group of the methods employed and the results.
The candidate is able to plan and teach a lesson. Is able to listen to a tape recording of a lesson and criticize it.	Tape recording of lesson. A written critique of lesson.
To be able to evaluate and criticize elementary science materials.	A written review of elementary science materials.
To be able to analyze children's responses in terms of levels of intellectual development.	A tape recording of tasks. A written analysis of children's responses.

THE UNIVERSITY OF TEXAS SCIENCE EDUCATION CENTER AND
THE RESEARCH AND DEVELOPMENT CENTER FOR TEACHER EDUCATION
Austin, Texas

David P. Butts
Science Education Center
The University of Texas
Austin, Texas 78712
(Telephone: 512-471-2343)

PROGRAM DESCRIPTION (Preservice, In-service):

Objectives of the Project

To create within the prospective teacher the courage and the confidence to sit down with tomorrow's problems in teaching science, to face these problems, and to use positive approaches to their solutions - and to accomplish these three tasks in a context in which the individual's personal concerns are both aroused and resolved as they have individual needs is the objectives of this project.

Population Served

A. Preservice elementary and middle school teachers who will have a responsibility for teaching a variety of the currently developed science curriculums such as the Elementary Science Study, the Science Curriculum Improvement Study, and Science - A Process Approach.

B. Inservice elementary school teachers who will be teaching Science - A Process Approach in Levels K-7.

Product To Be Installed

Description: A complete instructional system for a 45 hour teacher education program (a 3 semester hour course or inservice). This system includes Self-Directed Learning Guides for students, Analysis of Teaching Behavior module, Stating Instructional Objectives module, Instructor's Guide, laboratory apparatus for students, and demonstration materials for instructors. These materials include alternative instructional strategies for components of them such as self-paced instructional materials (Self-Directed Learning Guides), group administered instructional materials (Analysis of Teaching Behavior module, Stating Instructional Objectives module), and computer assisted instruction materials (Stating Instructional Objectives module). The entire course is ready for installation in early 1971 (see Appendix List of Materials for a more complete description of the program and its rationale).

Benefits, with verification procedures and data: In general, the outcomes of this program are based on the strategy of assessment of needs, awareness to the student of his individual needs, and through this awareness, arousal of his concern for these needs, and then strategies by which the student may resolve his individual needs. Such a program is educationally relevant to the needs of

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Each teacher needs to have skills essential to using or processing information of science experiences.	A self-directed learning format permits the personal competence to be developed in ways that facilitate optimum individual development.
An insight into the relationship between goals on specific learning experiences is essential if a teacher is to be able to intelligently redirect learners' efforts when needs or interest changes indicate.	Throughout the program a model of how to fit a variety of activities to specific instructional goals is presented--and ways to do this for both group or individualized instruction.
Instructional activities have many ways in which they can be directed. Rarely will the pupil attain more than that which the teacher envisions as possible. Searching for specifiable minimum expectations for learning activities results in teachers who have a focus or reason to justify the learning experience for pupils.	With respect to this goal, the strategy is mainly one of modeling the behavior initially, and then gradually shifting responsibility for acting to the teacher.
The philosophical common denominator of current emphasis of science curriculum is the dependence on real experiences with stuff as a basis for generating cognitive and affective changes in pupils. Such an emphasis requires appropriate amounts of resources at the right time.	The strategy for this goal is simple. You cannot guide pupils in learning what you have not done. Therefore as one essential ingredient of any plan for science instruction, the teacher must do each of the learning activities with the resources that are to be available for the pupils.
Curriculum designers have a responsibility to describe at least one way to successfully guide pupil learning toward those goals they have identified as feasible and desirable. Teachers must have the skill needed to identify what goals fit their pupil's needs and what alternative learning experiences may better fit their pupil's interests.	For each instructional objective, first through modeling and then through performance, each teacher experiences at least three different contexts in which a pupil might be guided toward achieving a given objective. These alternative contexts or learning activities are selected from at least two curriculum programs.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
By the end of the program, each teacher should be able to demonstrate the behaviors described in the objectives for instruction.	Two types of performance evidence are utilized: 1. Performance of process on the Science Diagnostic Tasks. 2. Performance of skills on the Pupil Diagnostic Tasks.
By the end of the program, the teacher should be able to identify or construct learning activities to fit instructional objectives.	Depending on the grade option the student selects, they demonstrate the behaviors in planning at least 4 science instructional units.
By the end of the program, the teacher should be able to construct diagnostic activities to match instructional objectives.	Performance or behaviorally stated objectives mostly remain words on a page until the teacher makes them operational by describing what they would ask a child to say or do to demonstrate the behavior. Success here is the comparison of the teacher-constructed diagnostic task with the objective which it is supposed to be measuring.
By the end of the program, the teacher should be able to identify specific equipment needs and resources.	The evidence for success in this goal is analysis of the teacher's data for the learning activities, and the specificness of the direction sheets for pupils to use as they are to have the opportunity to work with the resources.
By the end of this program, the teacher should be able to identify and describe three modification or alternative learning activities for each objective to meet the needs and interests of pupils.	Analysis of the Personalized Learning modules which are developed by the teacher at the end of the program permits the instructor and teacher to examine the consistency and logical coherence of the instructional objectives, diagnostic tasks and learning activities. Work which is not yet to satisfactory performance level can then be recycled for further development.

the prospective or inservice teacher, flexible in both its sequence and content, successful in terms of student achievement, efficient in utilization of student background and time, specific in its behaviorally defined minimum competency levels, and financially feasible based on field testing with a network with colleges and school districts.

These benefits have been and are currently being verified through a network of twelve college professors who have used the materials with both inservice and preservice teachers and in inservice programs at three large school districts. Field test data have been collected on both change in how students performed and how they felt about their experience.

Limitation for a potential adopter: The preservice version is best used in a situation in which there is some time flexibility and an instructor who is willing to permit self-paced instruction. Field test experience indicates that not all college instructors are comfortable in using a self-paced instructional format.

The inservice program is presently designed only for teachers who are committed to using Science - A Process Approach in their classrooms.

AVAILABLE MATERIALS:

A Partial List of the Curriculum - Based
Personalized Instructional Modules

Author	Product
	SELF DIRECTED GUIDES TO PERSONALIZING INSTRUCTION
(Hord & Butts)	Non-Instructional Management A Self Directed Guide to Engineering Learning Environments 1. Diagnostic Test 2. Student Guide 3. Cooperating Teacher's Guide
(Butts & Hord)	Planning Instruction A Self Directed Learning Guide to Deliberate Decision Making in Instructional Design 4. *Student Guide 5. *Instructor's Guide 6. *Diagnostic Test
(Butts & Hord)	Personalizing Classroom Interaction A Self Directed Learning Guide to Spontaneous Decision Making in Instruction 7. *Student Tasks 8. *Instructor's Guide

Author	Product
Butts	The Teaching of Science A Self Directed Learning Guide to Personalizing Science Instruction 9. Student Guide 10. Instructor's Guide 11. Diagnostic Test
Butts	Personalizing Instructional Planning for Science A Process Approach, Level A 12. Introduction 13. What's My Name 14. Shapes Around Me 15. On the Move 16. Groups of Things 17. New Tools for Seeing 18. Putting it in Order 19. Temperature and Time 20. Telling How Things Change 21. Classifying Your Observations
Butts	Personalizing Instructional Planning for Science A Process Approach, Level B 22. Introduction 23. Telling About Me 24. Observing Change 25. Measuring Things 26. Weather 27. Describing Change 28. Numbers Help 29. How Much 30. Seeds and Graphs 31. Tools for Measuring
Butts	Personalizing Instructional Planning for Science A Process Approach, Level C 32. Introduction 33. Living Sets 34. Communicating 35. Animals in Motion 36. Pictures That Tell 37. Explanations and Evidence 38. Parts to Whole 39. Measuring Things 40. Telling Where I am

Author	Product
Butts	Personalizing Instructional Planning for Science A Process Approach, Level D 41. Introduction 42. Fact or Opinion 43. Your World Around You 44. Mapping Your Environment 45. Change and How To Make It 46. Seeing the Whole Picture 47. Predicting What Happens Next
Butts	Personalizing Instructional Planning for Science A Process Approach, Level E 48. Introduction 49. Analysis of Stuff 50. The Shape of the Angle 51. Repeated Events - A Pattern 52. Changes 53. Rules for Spinning 54. Patterns in Electricity 55. Cylinders 56. Decimals in Science
Butts	Personalizing Instruction Planning for Science A Process Approach, Level F 57. Introduction 58. Variables in Camera and Seltzer Action 59. Operational Definitions 60. How to Learn 61. Who or Why Am I? 62. Plants Alive 63. Communicating through Pictures 64. A Moving Topic 65. Conclusions - Your Interpretations
Butts	Personalizing Instructional Planning for Science Curriculum Improvement Study 66. Introduction 67. Organisms 68. Life Cycles 69. Populations 70. Communities 71. Ecosystems

Author	Product
Butts & Hord	Personalizing Instructional Planning for Elementary Science Study 72. Introduction 73. Mirror Cards 74. Budding Twigs 75. Behavior of Mealworms 76. Starting from Seeds 77. Mapping 78. Tracks 79. Peas and Particles 80. Bulbs and Batteries 81. Match and Measure 82. Colored Solutions 83. Sand 84. Pendulums 85. Earthworms
Butts, Gibb, Hord	Personalizing Instructional Planning for Interdisciplinary Mathematics-Science-Grade 4 86. Introduction 87. What is Your Evidence? 88. Telling it Like You See It 89. M & M I (Money and Mapping) 90. M & M II (Making and Measuring Change) 91. Parts into Whole
Butts, Gibb, Hord	Personalizing Instructional Planning for Interdisciplinary Mathematics-Science-Grade 5 92. Introduction 93. Stuff and Sets 94. What's Your Angle 95. Searching for a Pattern 96. Changing the Whole 97. Spinning or Winning 98. Living Wholes 99. Patterns in Number and Electricity 100. Polling with Fractions and Cylinders 101. Decimals in Numbers and Physics
Butts & Hord	Personalizing Instructional Planning for Environmental Studies 102. Introduction 103. Plot Explorers 104. Plant Growth 105. How Long Can You Keep It Alive? 106. Animal Response to Man's Pollution

Author	Product
Butts & Hord	Interdisciplinary Mathematics-Science
	107. The Teacher Resource Book, Vol. 1- a collection of Science competence and confidence builders
Gibb	The Teacher Resource Book, Vol. 2 - a collection of Mathematics competence and confidence builders
	108. Fractional Numbers and Ratio
	109. Geometry
	110. Logic and Number Theory
	111. Integers and Functions
	112. Probability and Statistics
	113. Sets and Numbers
	114. Whole Numbers and Numeration
Gibb and Butts	115. Pupil Diagnostic Tasks in Mathematics and Science - Grade One
Gibb and Butts	116. Pupil Diagnostic Tasks in Mathematics and Science - Grade Two
Gibb and Butts	117. Pupil Diagnostic Tasks in Mathematics and Science - Grade Three
Gibb and Butts	118. Pupil Diagnostic Tasks in Mathematics and Science - Grade Four
Gibb and Butts	119. Pupil Diagnostic Tasks in Mathematics and Science - Grade Five
Gibb and Butts	120. Pupil Diagnostic Tasks in Mathematics and Science - Grade Six
	Mathematics Modules
Gibb & Englehardt	121. Manipulative Materials
Gibb	122. Concept of Number
Gibb	123. Numeration
Gibb	124. Addition
Gibb	125. Subtraction
Gibb	126. Multiplication
Gibb	127. Division
Gibb	128. Problem Solving

For information on single copies contact:
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Austin, Texas 78712

Prices for multiple copies available on request.

WASHINGTON STATE UNIVERSITY
Pullman, Washington

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General Biology
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PROGRAM DESCRIPTION (Preservice):

The Teacher Education Program at Washington State University prepares prospective teachers in an undergraduate teacher education program to assume roles in the elementary or middle schools. (Other programs at this University will not be discussed in this description of the program.) The basic sequence of the courses which now comprises the minimum entry competencies are the following: (1) Education 200, Career Seminar which emphasizes the improvement of one's self-understanding and the ability to work with others in addition to orienting prospective teachers to the career field of teaching; (2) Education 300, Human Development and Education, which emphasizes the learning processes and developmental processes of children and youth; (3) Education 401, Evaluation of Learning, Elementary, which presents the theory and methods of evaluating pupil progress for elementary school teachers.

The Competency Oriented Personalized Education (COPE) program has complted its first major field test year. The COPE program was utilized in part by approximately 240 elementary majors during the 1971-72 academic year to test a Washington State University developed model undergraduate teacher education program. Approximately 85 percent of all elementary undergraduate majors participated. Learning modules have been prepared in the COPE program which allow independent study as well as simulation and application (experimental) techniques, including micro-teaching and field experiences in local school classrooms.

The required professionalized subject-matter courses for all prospective elementary school teachers are the following: (1) Education 390 Elementary School Art; (2) Educ. 304 Elementary Education I which provides the methods and materials for teachers of reading, language arts, and children's literature; (3) Educ. 305 Elementary Education II which provides the methods and materials for teachers of science, arithmetic, and social studies; (4) Educ. 403 Social Foundations of Curriculum; (5) Educ. 405 Directed Teaching which is the supervised teaching in public schools; (6) Health Education 480 School Health; (7) Music 390 Materials and Methods; (8) Physical Education Professional 379 Physical Education for Primary Grades; (9) September experience of Observation in the Schools.

The professional education and professionalized subject-matter minor courses are a total of 41 semester hours. Students also select a teaching major of approximately 30 semester hours from a list of elementary school majors. This list includes the elementary school major of Natural Science which requires 36 hours in the following courses: Bact. 101; Bio.S. 103, 104; Geol. 101;

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
An understanding of children's habits of eating is necessary for a teacher candidate to learn to recognize and remedy children's attitudinal problems toward proper diets.	Teacher candidates will observe and interact with children to analyze their attitudes toward eating. This interaction enables the candidate to use various materials for recognizing, defining and prescribing remedial instructional strategies. Case histories and statistical studies will be used to explain some attitudinal problems.
Good habits of eating are based on an awareness of the nutritional contents of various foods. Ways of testing the nutritional values of foods are helpful for a teacher candidate to utilize those learning activities which will promote in pupils a proper concern over foods.	Transcribed classroom dialogues demonstrate to candidates how to involve pupils in gathering and interpreting data which is relevant for nutrition education. Pre-laboratory and post-laboratory discussions are essential to promote meaningful experiences.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The candidate learns to recognize the diversity of attitudes about foods. 2. The candidate learns how to select various instructional materials designed to meet specific needs.	Upon viewing a film or videotape of children with dietary problems, the candidate: 1. identifies and states the clues showing the need for remedial diagnosis. 2. proposes appropriate diagnostic and remedial strategies.
The candidate understands that the teacher must lead pupils through experiences by which they will discover the need for foods of appropriate nutritional value. Changes in attitude will occur more permanently in a democratic atmosphere which allows discussion and disagreement.	1. The candidate can be observed increasingly to make provision for pupils to collect and interpret data on the nutritional values of foods. 2. The candidate can be observed less and less to have the pupils accept the evaluation of foods on the basis of conclusions made by authorities.

Math. 105, 300; Phys. 101, 102; a sequence from Chem. 101, 102, 120; or 105, 106; or 111, 212. It is recommended that additional courses be chosen from among Astr. 135; Bot. 232; Env. S. 101; Geol. 102, 250; Zool. 220, 222, 251. Relatively few persons seeking the elementary school certification major in natural science.

Education 305 is the second block of professionalized subject-matter courses for all prospective elementary school teachers. Upon completion of Education 305 the student should have a general understanding of the current thinking in the teaching of elementary science, mathematics and social studies. In addition each student should have developed an initial philosophy toward a teaching approach in each of these areas. Finally, students should have attained specific tools and skills with which to teach these subject areas. Within this five-semester-hour course most of the prospective elementary school teachers have their only formal training in elementary school science programs. This course should make the students aware of the traditional text-centered programs and the newer science programs such as AAAS, SCIS, ESS, and others. Additionally the students should develop their questioning techniques and laboratory techniques for teaching elementary school science.

In late November of 1972, the National Dairy Council made a grant to Washington State University for the development of a nutrition education program for prospective elementary-school teachers. The on-going elementary program will be changed by the addition of modules into the following courses: Educ. 304, Educ. 305, Educ. 405. The students with the background of the modules when enrolled in Educ. 405 will be supervised in doing demonstrations and conducting experiments in the public schools. These activities in nutrition education will be supervised by the cooperating teachers and/or the supervisors of the student teaching centers. The supervisors will be prepared by special workshops held through Washington State University. Materials developed for these special workshops will also be used in conferences or courses for school administrators, and in meetings of professional associations. The title of the proposal is "Nutrition Education for the Elementary Schools through the Development and Evaluation of Teacher-Training Modules." Dr. David R. Stronck, Assistant Professor of Biological Science and Education, is the Director.

AVAILABLE MATERIALS:

Teacher-Training Modules in Nutrition Education for the Elementary Schools. Cost is unknown at this time, (on November 17, 1972 a grant was made to Washington State University by the National Dairy Council). Materials will be available no sooner than September, 1973, in their first trial edition.

UNIVERSITY OF WISCONSIN-EAU CLAIRE
Eau Claire, Wisconsin

Ben Thompson
University of Wisconsin-Eau Claire
Eau Claire, Wisconsin 54701
(Telephone: 836-5844)

PROGRAM DESCRIPTION (Preservice):

The aims of this science methods class are as follows:

1. To create a desire to teach children science.
2. To produce a positive attitude towards science.
3. To instill a knowledge of activitity and text centered programs.
4. To provide the basic skills for teaching children science.
5. To give practice in teaching children science in a typical elementary school classroom.
6. To acquaint students with current trends and philosophies affecting the future direction of science education.

The topics involved are:

1. The Nature of Science and You
2. Three Main Characteristics of Science
3. Cognitive Levels of Science Objectives
4. Stating Science Objectives
5. Classroom Activities--Children Doing and Watching
6. History of Elementary School Science--The Nth Time Around
7. Overview of New Science Programs
8. Using the Text to Teach Science
9. Observing
10. Measuring
11. Classifying
12. Communicating
13. Inferring
14. Predicting
15. Evaluating Process
16. Preparing to Teach
17. Research in Elementary School Science
18. The Classroom's Role in Science

The first four topics occupy about seven class meetings. A variety of techniques is employed. Just one example will be given here. Topic one, "The Nature of Science and You" begins when the students are asked---to write a short theme--What the word science means to me. This is the first thing done and should reflect none of the ideas to be presented. Next the students are provided with the list of concepts taken from the WISP instrument (University of Wisconsin-Madison). They are asked to respond to each item--accurate, inaccurate or uncertain. Again, before we interact. So far the ideas are what students bring with them.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Science consists of processes, products and is a human enterprise in which science and society interact.	Students first write a short theme titled "What Science is to Me." Then they react to twenty statements indicating whether they agree, disagree or are uncertain about the scientific accuracy of them. Some of these statements are about science and written by scientists. The rest are popular misconceptions or oversimplifications about science. Next students read excerpts about the meaning of science from books by well known scientists. Now, these students are ready to critique and modify their original theme "What Science is to Me."

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The student recognizes that elementary children should be exposed to science as product, process and science-society interaction. 2. The student develops a critical concept of science unlike that pictured in many science textbooks.	When asked to list seven general characteristics of science which fit no other discipline the student does so with reluctance protesting that science can not be so isolated from man's other activities. Statements like "Science has its own language" or "Scientists often work in places called laboratories" are typical. When critiquing sample science programs the student lists apparent weakness if the curriculum neglects to include the three aspects of science, process, product, interaction of science and society.

Now the students are given a list of responses scientists made to the WISP items and the differences apparent in student's concepts discussed in class. They see that not all scientists view science the same way. They also have their beliefs challenged.

Next the students read a handout of excerpts from books by scientists. Each student is given one or a pair of contrasting excerpts to read and then explain in small group discussion. The excerpt by C. P. Snow and Max Otto generally are sufficient in themselves. Others are compared with the excerpt from The Foundations of Science by Lachtman since he exemplifies the textbook image.

These divergent and sometimes spectacular points of view (At one point, Einstein says intuition not method is how his science progresses) are then contrasted with the original essay each student wrote (by this time it has been read and commented on--but given no grade) through large or small group discussion.

Lastly, each student is required to list 5 to 7 ways in which science differs from all other disciplines or "subjects". This provokes frustration since as things are listed they find the idea usually applies to art (experimentation), history (records of progress), library (classification), etc. Some possible differences are: a special language, practitioners called scientists, entire world as topic, etc. but these aren't indisputable either.

So what is science? Now they are uncertain. The important question is how do you, as an elementary teacher, present the ideas of science to kids. Certainly not as steps--nor as intuition. It's both and a lot more--that's what kids should learn. Then we focus in on science as Process-Product-Interaction with society and culture. Now the "methods" course begins.

Topic five "Classroom Activities" is presented as a demonstration and lecture with printed notes supplied. The main feature consists of showing the positive and negative moves in demonstrating by doing an actual demonstration pretending to have not prepared, reacting negatively to responses the teacher did not have in mind, telling the students what each step is while doing it and so on. The positive side is shown by using surprise, student involvement, open ended questions and so on. The "Doing" is amplified in many later meetings.

A handout outlining some phases in the history of elementary education is provided to students for the History of Elementary Education. This is accompanied by a lecture in which salient points are illustrated through reading directly from text books, journals, and reports of the period. Quotations from the past are matched with contemporary writings to show how ideas about teaching science have persisted or recurred.

Since most students will be provided with a science textbook as the major teaching device current texts are analyzed. In this exercise, students focus on types of diagrams and photographs, the use and levels of questioning, reading level, manner in which activities or experiments are presented.

After this some time is spent having the class devise a curriculum segment utilizing the text as reference material while expanding the program with "lessons" from ESS, MINNEMAST, COPES, SAPA, and SCIS.

The motivating force for the class develops from a two week terminal experience. At the end of formal science methods class meetings, pairs of students go into the Eau Claire public and parochial schools to teach science. In direct preparation for this, six sessions dealing with the so-called "processes" are held. Each session concentrates on one process and is a lesson taken from either the ESS, SCIS, or SAPA programs. These sessions run for one and a half hours. The students assume roles of second or third graders for example and do the exercise while the methods teacher becomes a grade school teacher. Materials are handled, discoveries made, conclusions reached, and lists put on the board.

After a brief discussion the students view a 15-20 minute videotape of children doing the actual exercise they completed or a very similar one. Next, students have an opportunity to ask questions or make comments about what they saw.

In preparation for the field experience, students contact elementary teachers who have indicated a willingness to cooperate with the science methods program. The teachers indicate what units, chapters, or activities they wish to have presented. Almost all use one of the ESS or SAPA programs.

Now the students plan a two-week sequence. Gathering material, providing for printed matter and giving advice requires an expenditure of considerable time from the methods instructor, since 40 to 50 pairs will be out in the schools at one time and since these teams require continual help and equipment, there is no opportunity to observe on his part.

Evaluation is minimized and the host elementary teacher merely checks the effort and effectiveness of the team members. Students feel they can be more concerned about their tasks if they are not worried about being watched. In reality, the best criteria of success is to be found in the comments and continued support our program has received from the elementary teachers involved. Occasionally we find a disappointing experience but no disasters to date.

Our students say teaching is what methods courses are all about and the terminal field experience gives them a goal to work for from the first day of class, with some skills and memories to take into their senior practice teaching experience the following year.

AVAILABLE MATERIALS:

Videotapes of children being taught with SAPA material. (Cost: Return postage)

SECTION THREE: SECONDARY SCHOOL SCIENCE TEACHER EDUCATION PROGRAMS

NORTHERN ARIZONA UNIVERSITY
Flagstaff, Arizona

Gordon Johnson
Northern Arizona University
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PROGRAM DESCRIPTION (Preservice):

The program of preparation for the preservice teacher in the physical sciences involves the usual three major components:

1. A Liberal Studies requirement of 42 semester hours. This normally includes, for the prospective science teacher, two courses in the History of Science and the Philosophy of Science.
2. An area of specialization of 50-60 semester hours, which provides several options. A recently introduced and strongly encouraged option is that of coordinated teaching majors. This allows the prospective science teacher to pursue intensive preparation in two complementary teaching areas, such as chemistry and physics, physics and mathematics, or any of several other logical combinations.
3. A professional block of 20 semester hours. Prior to admission to teacher education, a student takes the 2 hour Introduction to Education course (team taught with laboratory experiences) and the 3 hour Educational Psychology course (also with laboratory experiences).

The remainder of the experiences are normally completed during a professional semester. The Secondary School Curriculum, and Evaluation of Learning courses are presently taught in a block during the first eight weeks of the semester. In some instances, the special methods class may be taught with the above courses in a teaching center, located in a secondary school off campus. This allows easy access to observation and participation experiences on the scene of the student's upcoming student teaching experiences. Student teaching is a full time eight week experience concluding the professional semester. Formal and informal seminars are scheduled during the time of student teaching.

The special methods courses and the supervising of the student teaching experiences along with advising are the responsibility of specifically designated persons in the science departments. The remainder of the professional experiences are the responsibility of persons in the College of Education.

The special methods course is currently organized for prospective teachers in the area of mathematics and the physical sciences. For the most part this involves a single group of students--the majors in mathematics most often have a minor or coordinated major in one of the physical sciences while the reverse is just as often true. Opportunities are also available for students to participate part-time in the special methods course in Biology if a portion of their training is in that area.

An auto-tutorial laboratory is available for members of the science methods classes. Here opportunities are provided for the student (1) to become proficient in certain laboratory skills necessary for the secondary science teacher, (2) to observe prepared videotapes illustrating teaching styles and classroom activities, (3) to use materials (textual and laboratory) that have become recently available, (4) to review summary filmstrip and audiotape descriptions of the newer science programs at all levels, K-12, (5) to develop auto-tutorial modules for future use by secondary school students, and (6) to become familiar with the operation of recently available equipment.

Students all have an opportunity to participate as the instructor in a micro-teaching situation, to view a videotape of their own performance, and to participate in a critique of their teaching performance. Participants are encouraged to work toward development of their own teaching model or style on the basis of (1) their view of the nature of science, (2) their rationale and philosophy of science teaching, and (3) their understanding of the learning capabilities and characteristics of the population of students with whom they will be working.

A variety of teaching materials and resources are then examined and the student encouraged to select those that will best fulfill their perception of the goals of science teaching.

Since the specifics of his student teaching experience are available to him at the time of his beginning the methods class it is quite easy to direct many of the activities of the methods class to a defined and easily observed situation. Follow up opportunities are also possible during the student teaching experience. In that sense the methods class is readily extendable throughout the student teaching experience. In the same way many of the observations done normally at the beginning of the student teaching experience can be accomplished during the first 8 week period.

In addition, the methods instructors teach a number of sections of the non-science major science courses. This allows actual demonstration of teaching styles, goal emphases, and teacher-student interaction on a practical level but hopefully consistent with the ideas advocated and advanced in an intellectual way during the discussions in the methods classes.

AVAILABLE MATERIALS:

None listed.

AUSTIN PEAY STATE UNIVERSITY
Clarksville, Tennessee

John Czirr
The Center for Teachers
Box 4515
Austin Peay State University
Clarksville, Tennessee 37040
(Telephone: 615-648-7187)

PROGRAM DESCRIPTION (Preservice, In-service):

The Center for Teachers, a program of Austin Peay State University partially supported by the National Science Foundation, is a service organization designed to assist school administrators and pre-service and in-service teachers of high school science or mathematics. The major programs of The Center are based upon school needs as identified by the teachers and their administrators. They are implemented by providing (a) activities to meet these needs, and (b) physical and financial support for these activities. Pre-service programs have been developed in chemistry, earth sciences, environmental sciences, mathematics, and physics. Additionally, continuous, coordinated professional assistance for in-service teachers in 21 school systems of rural Tennessee and Kentucky are provided through The Center. In-service programs of a variety of kinds are provided in all these fields, plus biology.

Keeping in mind the realization that the continuing welfare of the student must be the ultimate goal of any properly conceived educational program, and the student and program must be brought into effective contact to achieve this goal, the objectives of The Center have been set up as follows:

1. To establish a pilot program of services for science and mathematics teachers, operated as a center of continuous, coordinated activities for pre-service preparation of teachers in five disciplines, and for in-service assistance to teachers in twenty school systems in the vicinity of the University.

2. To make The Center a communications facility for identifying the needs of the school systems and a working facility for providing: (a) programs to meet these needs, and (b) means for participation of teachers and administrators in the programs.

3. To develop and/or improve undergraduate curricula specifically directed toward the pre-service preparation of teachers of the various sciences and mathematics.

4. To secure, store, and display the abundant instructional materials (including apparatus) extant and forthcoming, and to provide space and personnel to insure easy access and maximum usage of these materials by both pre-service and in-service teachers.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Teachers will be able to adapt national curricula to their own local needs.	Pre-service teachers are exposed to many national curricula and are provided with the opportunity to try them out, in part, within the structure of the local schools.
The teacher will utilize a multi-media approach in the classroom.	Pre-service and in-service teachers are provided with free production materials and are aided by specialist in learning how to produce and utilize media type teaching aids. Professors encourage, through special assignments, the use of multi-media approaches.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Teachers should learn to utilize those parts of national curricula that fit the local school environment and to adapt those that do not readily fit.	Ideas and materials from national curriculum projects are utilized in the classrooms.
The teachers shall become self-reliant in the production and use of multi-media materials.	The teachers will produce and use these materials in their classes.

5. To provide reference and resource materials and persons to supplement the primary sources listed above.

6. To develop into finished products or adapt as innovation the views, suggestions, inquiries, or experiments of participants; then to channel these effects into usefulness as apparatus, instructional media, and other teaching aids for in-service teachers, pre-service teachers, and the staff of The Center. Special emphasis will be placed upon assisting individual teachers in developing their own ideas into usable materials for their classes.

The University provides space and furnishings for The Center including conference rooms, classrooms, laboratories, work shop, lounge, and other appropriate space, including offices for the ten full-time employees. Thirty university professors are released from approximately half of their regular university teaching load to support various activities of The Center.

The in-service phase of The Center is based, to a major extent, upon needs identified by the teachers and their administrators. Mechanisms for participation of these teachers and administrators are as follows:

1. Single-topic institutes of one week's duration are held throughout the academic year with small (7-10) groups of teachers attending each institute. Topics are selected by the teachers and programs are prepared by The Center. Teachers with common interests work in groups of three or four assisted by professors from the University and by Center staff. Housing is provided by the University, with meals and travel expenses supported by the National Science Foundation.

2. Occasional one-half day sessions are held for the benefit of superintendents, principals, guidance counselors, and supervisors in order to be certain that they all have a broad understanding of the work of The Center and to increase the probability of their assistance in making good use of the increased capabilities of the teachers. The University bears the expense of these meetings. Additionally, meetings with some local school boards have been held and appear to be quite profitable.

3. Short courses of three weeks' duration are being taught during the summers to provide intensive coverage of selected topics. These courses carry optional graduate credit of three quarter hours for those people who are eligible for graduate credit and who desire to receive it. Fees are paid by the University; stipends are furnished by the National Science Foundation. Occasional one-week institutes for principals are held to help them become more fully acquainted with the philosophy and content of the new science courses they administer. Housing is furnished by the University and the necessary materials by the National Science Foundation.

4. Staff members of The Center and members of the University faculty visit each teacher in his school at least three times during each year to assure continuity of professional stimulation and provide other services. These visits include time for brief conferences with principals, supervisors and guidance counselors.

5. To alleviate partially the conditions of poor communication with teachers, the University provides toll-free telephone service from each school to The Center, thus affording the teachers easy access to Center resources which, of course, include the total resources of the University. Calls are anticipated for information on an immediate-need basis, but telephone service also encourages inquiries that can be satisfied only by correspondence or by visitation.

AVAILABLE MATERIALS:

Descriptive brochures for the overall program, the Media Division, the Materials Division, and each of five content area projects respectively. (Free, 8 brochures)

CALIFORNIA STATE UNIVERSITY
San Jose, California

Jean Beard
D. R. Conradson
J. L. Rhoades
R. A. Smith
California State University
San Jose, California 95192
(Telephone: 408-277-2322)

PROGRAM DESCRIPTION (Preservice):

The current secondary science credential program is pursued during a fifth year, following completion of a bachelor's degree and acceptable preparation in biological and/or physical sciences. Course work in the fifth year includes: 1) professional education covering topics such as curriculum, general secondary school orientation, educational psychology, general methods, evaluation, and audio-visual techniques; 2) science education: methods, and seminars on student teaching and current innovations in science teaching; and 3) science: usually limited to two or three upper division courses. The first semester of the fifth year is occupied primarily by education and science methods courses, in preparation for a second semester primarily devoted to student teaching in two science classes per day (8 semester units) and related seminars.

A new law to be implemented over the next few years makes it possible to complete a bachelor's degree and credential program within four years. This will reduce science major courses to about 45 semester units, probably reduce the number of teaching minors completed, and reduce the time spent on professional education course work. Provisions of the law require a course in methods of reading and increase student teaching to a minimum of 12 semester units. We are then in the process of selecting the most "promising practices" as well as omitting and adding activities expected to improve the program. It will be at least a year before we work with anyone in the new professional program, but at this time we have some experience in two innovations which precede the credential portion of the program. These and several features of the science education portion of the current program will be described in more detail. The portions not expanded here are thought to be successful, but commonly in use elsewhere and thus not in need of further description.

A basic premise in our science teacher education program is that specific techniques for a certain laboratory or curriculum program are not appropriate to a methods class. An attitude of constant improvement, experimentation, and openness is preferred to slavish devotion to a program or technique or to blindly redoing what is "party line" activity.

Each of the practices described occur as portions of the science education program which is the sole responsibility of the Department of Natural Science, for the School of Science.

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
A self-renewing teacher must be cognizant of high(er) goals and limitations.	The preservice teacher is asked to develop a set of objectives for himself as a student teacher. (SCIED 373)
Effective teaching of individual students requires information about student characteristics such as: background, interest and attitudes. A "good teacher" must often infer such student attributes from observation of classroom activities.	Observe individual student in various science class situations: Lecture, lab, discussion...(SCIED 373)
Lesson planning must provide for a continuity of learning experiences.	Teach (1 or 2) 3-5 day lesson sequences to small (average 5) groups of students. (SCIED 373)
Teaching is an interpersonal art.	Individual and small group counselling to bring out evidence of individual differences of students and teachers who must work together. (SCIED 373)

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
School and University supervisors are better able to assist in professional growth of student teacher.	Realization that teachers must be self-renewing at least in part.
Pre-service teacher begins to develop skills for estimating individual student: readiness, attention span, interests, learning skills...	Pre-service teacher prepares lessons which allow for expected individual student variations.
Pacing, allowance for student variance, and topic continuity are considerations in lesson planning and teaching. Teaching strategy effects outcome with students.	Considerable revision of plans for subsequent days in response to new experiences in time requirements, student difficulties and interests. ("How can you go back to face the same kids and do better each day?")
Ability to describe and show differences of student acceptance and rejection response to varied classroom procedures.	Plans for classroom activity to accommodate for individual differences in students. Modifies plan in response to student behavior.

Nat. Sci. 108: Experimental and Investigation Techniques in Science. 3 semester units. This new "course" will be taught for the first time beginning in February 1973. Its development resulted from the contradictions which arise when students trained almost entirely about the products of science endeavor are asked as teachers to give students experience in science as a problem solving process.

The loosely structured lab-seminar is required for the new science teaching majors and recommended for other science majors. Several basic seminar topics related to science philosophy are to be coupled with an opportunity for each student to actually carry out some open-ended investigations. It is expected that a generally open atmosphere will have to be accompanied with individually determined forms of encouragement for students who as sophomores and juniors have found success and comfort in science as a body of knowledge.

Sci. Ed. 175: Classroom Experiences in Science Teaching. The career decision course is intended to acquaint undergraduates more fully with teaching, from the teacher's point of view. Students will be assigned to an elementary, junior high or senior high school teacher depending on the level of his interest. A minimum of three hours a week is scheduled in the teacher's classroom, but the experiences are determined by the teacher and student as appropriate to the classroom plans, pupil needs and student interests and skills. In a metropolitan area we have been fortunate to find a group of dedicated classroom teachers willing to assist and counsel. Success from last year's initial offerings show a sharpening of teaching interest or a rejection of a teaching career option - both of which are considered useful to college sophomores and juniors. Further data and analyses will become available in Diane Conradson's doctoral dissertation when it is accepted by the University of California, Berkeley, early in 1973. Her investigation is on attitude variation produced by this experience. There are now students taking this "course" for the third (maximum) time, at the third educational level, to further assist in their career decisions.

THE CITY COLLEGE
New York, New York

Harold J. McKenna
School of Education
The City College
New York, New York 10021

PROGRAM DESCRIPTION (In-service):

The environmental problems confronting society have two fundamental aspects: the scientific and biological on the one hand, and the social, economic and political on the other. In order to deal with the social, economic and political aspects of a given problem rationally, one must have a grasp of the inter and intra relationships of ecosystems. In this regard, environmental problems can be viewed with an understanding of population and community needs. Through an ecosystem analysis, the various scientific and social views of society can be viewed, analyzed, synthesized and applied to the many environmental problems facing the biosphere today.

It is this belief that has prompted the City College of New York, School of Education to undertake and develop an entirely new graduate program in environmental education for teachers of science and social studies at the secondary level. From a survey taken of some 70 colleges and teaching institutions throughout the U.S.A., of which 53 responded, none are offering such a teacher training program designed specifically for secondary school teachers of science or social studies as will be described.

The purpose for such a program is to prepare school personnel for leadership roles in environmental education. This program will provide course work and skills necessary for curriculum enrichment and will prepare teachers as both specialists and generalists in the field.

The unique feature of this program is that it has a two-way interdisciplinary approach. First it crosses departmental lines, and offers a flexible program of study from which the many disciplines are fed into it. Departments that will participate in this program include: biology, chemistry, geography, sociology, political science and economics. Many institutions throughout the country have such offerings from the various disciplines or departments, but are not geared directly towards teacher training. Some courses are: social ethology, radiation biology, ecological energetics, environmental law, chemistry of pollution, environmental politics, conservation, and economic geography. In these courses, students will be presented with the basic issues in which they will analyze each in light of that discipline as well as others, and develop various approaches to uncovering scientific method and attitude, economic policy and political structure of the environment.

The second aspect of this two-way interdisciplinary approach is that an interdisciplinary approach will be built into each of the courses. Each course will consider the social and scientific views, and cross develop in three basic ways: one way is content development in ecosystem analysis within

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Environmental education eventuates in knowledge which is based on an inter- and intra-disciplinary process.	Interdisciplinarily, students analyze various problems using the facts and information from both the Natural and Social Sciences. Intra-disciplinarily, students are given specific teaching methods in how to teach the content, interdisciplinarily, and how to become actively involved in a Community Environmental Project.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The student, holistically can analyze, synthesize and apply the knowledge of the disciplines to solving a problem.	Student actually uses the facts from sociology, anthropology, economics, political science and natural sciences to analyze an environmental problem holistically.
The student (in-service teacher) can use various methods and actions with the classes in teaching issues in environmental education.	Students use specific methods and actions in their classroom.

each of the disciplines. In other words, if you are discussing environmental politics, various ecosystems will be analyzed in view of present political action and structure. A second way is in methodology. Here students will learn various methods of approaches of teaching at the secondary level about the issues of each course. For example, in a course such as the chemistry of pollution, the instructor will give some methods in sampling water and introduce various chemical tests that a student can use in order to grasp an understanding of the problem. Thus, we are incorporating methods of how to teach a skill or concept right into each course, rather than giving a separate course only in methods! It is the contention of this writer that each expert in the field should be able to relate the proper method of instruction to the teacher, with the teacher's assistance, in each of the courses offered in the program. Thirdly, each course has a built in action involvement project, where students become involved in an issue and develop a political, economic, social or scientific action in their community to bring about some meaningful change in attitude (McKenna, 1971). Here students become directly and practically involved in the various disciplines and attempts to better understand problems and implement change.

This two-way interdisciplinary approach is developed throughout the entire 30 credit graduate program which leads towards a Master of Arts degree with a major in environmental education. As you can readily see, the program needs a flexible staff that has the ability to relate not only to content from his major field (specialist approach), but the content of other fields as well (generalist approach). Furthermore, the instructor should be able to relate methods or approaches of how to teach this content to students at the secondary level.

Now that the philosophical base of the program has been briefly reviewed, further expansion of the total program is needed. The entire 30 credit program will be divided into 3 major categories in which each will be integrated with one another in order to preserve the continuity of thought and understanding.

Category I - Environmental Studies Core - in this category there will be 3 fundamental courses required of all entering students. The purpose of this category is to develop a strong understanding of the ecosystem concept in both the social and scientific disciplines. Furthermore, an environmental field studies course will integrate these concepts by bringing the students into the field in order to actually use their senses and skills in gathering data and information, and drawing conclusions on what actually is happening with that of theory.

Category II - Common Professional Requirements - in this category, students will meet their professional requirements as teachers by developing systems of communications through workshop courses, seminars - for developing curriculum materials, and independent research study on specific issues which a student is interested.

Category III - Electives - in this category, students will select courses from the various disciplines which will meet their individual needs for a better grasp of the ecosystem concept and environmental issues. In this way, science majors may select courses directed more in economic, and political areas, while social studies majors may select courses more scientifically oriented.

One should keep in mind both of the two-way interdisciplinary relationships that each course in each category has built into it. Furthermore, each category is inter-related in order to develop the conceptual framework of the interdisciplinary approach.

As a pioneer in this area it is hoped that this approach will give new insights to our teachers about evaluating our environment and about involving students. These students will become the informed citzenry of this country who will be making crucial decisions in the future as to the survivial of our ecosystems!

AVAILABLE MATERIALS:

Program of study for the M.A. in Environmental Education. (FREE)

Course outlines for courses in programs. (FREE)

Field guides to New York City. (Cost to be determined)

An Innovative Program in Environmental Science Education: Research and Evaluation. (At press - cost to be determined)

For materials write to: Harold J. McKenna
The City College
School of Education
137th Street & Convent Avenue
New York, New York 10031

UNIVERSITY OF COLORADO
Boulder. Colorado

Harold M. Anderson
University of Colorado
Hellems Annex 247
Boulder, Colorado 80303
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PROGRAM DESCRIPTION (Preservice):

Few teachers express strong approval of their teacher preparation experience. Almost three years ago the University of Colorado secured a feedback evaluation of their program from recent graduates. The results of that study emphasized the common charge that campus study of education has only limited relationship to problems encountered in school situations, especially so when the campus education precedes the school experience.

Acting upon the results of that survey and being fortunate enough to secure an UPSTEP grant, the School of Education at the University of Colorado drastically revised its secondary teacher education program. (The elementary program had begun revision the previous year.) The actions came as a result of much deliberation at numerous meetings. Since many decisions did not meet with universal approval, a number of compromises were necessary.

During the spring and summer of 1971 several faculty members examined available modules and prepared new ones. A considerable number of modules were available. However, many did not serve the purposes of our faculty. New modules were prepared by several faculty members while carrying on their normal teaching duties.

Participants for the 1972-73 Secondary Professional Year were selected during the spring of 1971. Criteria for selection were 1) suitable subject matter preparation and a grade point average of 2.5 on a 4 point scale, 2) willingness to commit the entire year to teacher preparation, 3) an interview with one or more professors, 4) prior experience with adolescents in an institutional or quasi-institutional setting. Public school science teachers examined the papers of science applicants and interviewed the prospects. One hundred one candidates started the program in the fall of 1972. Eight of these were in science.

After a fall, 1972, orientation meeting these eight teacher aspirants (called a stream) and I (stream leader) reported to a junior high school and met with the science department to plan for the opening of school. For two weeks the prospective teachers participated in the school activities on a full time basis; running errands, observing, visiting various teaching situations, and noting how some order was produced out of opening day chaos.

For the remainder of the session our students were to spend approximately one half day in a public school as instructional assistants and the remainder of the time at the university working on professional education modules and

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
The art of teaching (allowing children to learn) is learned by guided experience in practical situations. Associated theoretical structure is need to analyze, evaluate, and increase the skill in practicing the art.	Teacher candidates get early experience in helping students (and teachers) in real school situations. Questions are raised about teacher actions or pupil reactions which may be expected to stimulate learning and inquisitiveness on the part of the candidate.
The prospective teacher will learn more efficiently if he has an opportunity to help plan his program and to discuss his needs and performance with professional university and public school personnel.	The university "stream leader," the teacher candidate and science teachers at the school select experiences and modules for the teacher candidate to study or participate in. The candidate recognizes his activity as an important step in his progress toward becoming a professional.
Each prospective science teacher has individual needs and strengths by virtue of his past experiences, personal talents, etc. To require the same material of all candidates is inefficient use of student time. Fixed courses and rigid outlines can be replaced by modular study and personal activity.	No fixed courses are required. Modules that have rationale, objectives, resources, activities, and evaluative devices are made available for individual selection and study.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The candidate recognizes the problems that exist in the school situation. The candidate desires to explore other approaches that may be used in teaching.	The candidate lists a number of problems that have been encountered. The candidate asks or offers suggestions about other ways to handle situations.
1. The candidate learns to analyze his own strengths and weaknesses. 2. The candidate learns to discuss his situation objectively and responsibly.	The candidate analyzes his own teaching (videotape or recording) and identifies his weaknesses. The candidate will search for and/or suggest lessons or activities that help him as an individual.
The candidate successfully studies modules or participates in activities that complement his strengths and remedies identified weaknesses.	The candidate uses the material he has studied to improve his planning or performance in school situations.

doing a limited amoung of science course work. The integrated science department, as a part of UPSTEP, prepared some courses so that they could be done on an independent study basis, involving some group conference.

The stream and I meet at least once a week to discuss problems and to plan. On some occasions teachers also meet with us. In addition, many conferences are held with individual instructional assistants and cooperating teachers. This constitutes informal evaluation and can serve as the vehicle for arranging termination of unsatisfactory performers.

During the fall semester the instructional assistants have studied foundations of education, educational psychology, secondary education methods and communication for teachers through independent and small group study of modules. In addition there has been some activity in science education.

A period of nine weeks during the spring term will be devoted to full time student teaching. During this time students will teach under supervision of cooperating school teachers and the university supervisor. In this respect the program differs very little from the older program, with one exception. The science methods course which has been partly modularized will be havily oriented to the students' teaching activity. Some work in methods will be done in the school and some in group and individual meetings in our science resource center.

During the last six weeks the students choose an alternative field/educational experience where they elect to work in another kind of situation. It may be in other levels of school, in an inner city or rural high school, in an alternative private school, in a reformatory school, or in a situation such as the Bureau of Indian Affairs.

The program has experienced some problems in communication and coordination. Many of our modules need to be revised. This program requires more time on the part of the faculty. But the improved reaction of teacher candidates and the cooperating public school faculty is encouraging. It is our hope that this will result in improving professional relations as well as improving our teacher education product.

AVAILABLE MATERIALS:

Models we are using this year in Science Education to develop group cohesion:

1. The Task Before Us, by H. Anderson
2. Accident Prone - or Lucky, by H. Anderson
3. What Shall We Do Tomorrow, by H. Anderson
4. First Day Science Activities, by Russ Zeaney
5. Secondary Science Curriculum Module,by Russ Zeaney
6. Some Math and Stat for BSCS Biology Teachers, by Russ Zeaney
7. The Nature of Science, by Ron Anderson

$2.00 for set of 7 modules. (These need revision and are not exemplary.)

UNIVERSITY OF COSTA RICA
San Jose, Costa Rica A.C.

Dean Jesue Ugalde Viques
Faculty of Education
University of Costa Rica
San Jose, Costa Rica A.C.

PROGRAM DESCRIPTION (Preservice):

The first two years of the program are devoted primarily to studies in the sciences, psychology, philosophy, humanities and general education. Since most of the students are registered through the College of Education, their progress is noted and adjustments are made as necessary both between and at registration periods.

The third year continues to provide background in the sciences but a consideration of the fundamental concepts related to teaching and learning becomes a major part of the program. There is some involvement with high school students, and strategies related to teaching-learning are examined with special seriousness. The future teachers examine the mandated curricula and plan for a reorganization that provides for greater stress on the fundamental concepts of science. A varied collection of activities, audio-visuals and other aids to learning are planned and many of them are produced so that they are ready for trials with high school students. In some cases they are tried out in preliminary form and suggestions made by students and teachers are considered in the production of the materials. There is much interaction among the future teachers and the supervisors in the planning and production of materials. A master file of ideas for activities is being developed in a materials center so that student teachers may seek ideas for use with students.

The entire fourth year is devoted to experiences in the schools. At first this is largely concerned with observing facilities in the school in general while observing a variety of classes. Student teachers are urged to note low and high deviates and what is being done to adapt materials so as to achieve optimum learning. Reports of their observations are required and form the bases for both group and individual discussions. Very soon the student teachers become involved with individual high school students, especially those students who the regular teacher finds it difficult to serve effectively while he is involved with the many students that commonly are assigned to his classes. Sometimes the special involvements of the student teacher are concerned with small groups of students as an alternative to the regular class instruction. Such involvements become more common when the student teacher is definitely assigned to a school and a teacher for the major student teaching experiences. The challenge to the student teacher is to help each individual student reach an optimum degree of achievement. For some students this may be a minimum degree of mastery of important concepts while for others the mastery would go far beyond that expected of the usual high school student. Seeking to achieve favorable changes in attitudes toward learning often becomes a greater challenge than attaining what is commonly expected of them.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Mastery of the major concepts of the sciences which teachers hope to develop with high school youth. Mastery of the skills that are effective in bringing youth to use the concepts wisely in personal, group and community situations.	Future teachers interact with University professors in classes, laboratories and discussion groups. The background obtained is used in planning experiences whereby high school youth grow in their ability to answer questions and formulate explanations in those situations that relate basic ideas to the concerns of youth.
Understanding the unique abilities of high and low deviates that require personal guidance for optimum development. Also an understanding of the common knowledges, skills, concepts and attitudes of a grade group that makes possible group guidance for individual progress.	Future teachers observe experienced teachers who give individual and group help to high and low deviates. Future teachers plan a variety of guides for direct, recorded and printed use together with the materials that provide opportunities for real experiences with phenomena and materials.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The future teacher masters the major concepts and understands how they are used to explain theory and practice.	Formal and informal evaluations reveal the degree to which the future teachers grasp the important concepts.
The high school student by individual efforts achieves the skill to grasp relationships and to explain common events in harmony with an acceptable level of conceptual mastery.	Formal and informal situations show whether or not a student acts intelligently in light of major concepts when confronted with questions and with phenomena with materials that are based on the concepts.
Each future teacher comes to understand the special needs of high, low and typical achievers. They become skillful in the planning of activities that provide meaningful experiences for groups as well as for individuals that require special guidance for optimum progress.	The future teacher is observed while serving individual students as well as small groups. He is required to justify the activities proposed and to explain the degrees of success obtained with individuals and groups. Mastery tests are also constructed, used and interpreted.

During all the involvements of the fourth year the student teachers are observed both by their regular teacher in the school and by one or more supervisors from the University. Since these supervisors have all been, and many of them continue to be, involved in high school teaching, there are rich opportunities to exchange suggestions and concerns. Conferences (individual, class and group) continue to be an important part of the student teaching experience. Each week there is a total student teacher seminar to consider common problems, to explain some special innovative procedures, and to consider the concerns of each future teacher. Since the travel of University supervisors is a serious problem, this initial teaching under supervision is done in schools at a convenient distance from the University. While there is now in operation a junior high school level practice school, the facilities are so limited that widespread use of this setting is impossible. Future plans call for a new modern building for both the junior high and senior high school levels.

The second term of the fourth year makes it possible to plan for student teaching in more distant locations. While observations and conferences will be less frequent, they are not eliminated. Each student teacher is expected to come to the campus each week for both individual and group conferences. The more distant schools, often with teachers who have limited preparation, make it possible for the student teacher to become deeply involved in the school and community, since it is necessary for the student teacher to live in the community. Such assignments to distant schools are ideally reserved for those student teachers who have shown high dedication and skills. Some student teachers with lesser development may continue to serve in schools near the University where they may receive more observation and counsel. Some other students who demonstrated inferior dedication and skills may be encouraged to seek other careers or to extend their studies until they present a mature attitude and serious dedication.

AVAILABLE MATERIALS:

Several pamphlets similar to chapters of a book are available in Spanish. About seven are in use and an additional ten or twelve are in preparation. Each explains and discusses some major conceptual area related to teaching science. These are used largely as settings for discussion and to avoid lectures. (Since transportation costs are high, it seems best that interested persons should write for details.)

A generous number of Invitations to Reasoning are available in Spanish. These can be used directly in classes but they also serve as examples for future teachers to create additional "invitations" based on local materials and conditions. (Write for details)

A few Audio-Tutorial group experiences for high school student use have been developed (also in Spanish). They involve a cassette and a collection of charts and materials so that a teacher can observe teaching and learning with freedom to note ways to improve their work. (Write for details)

UNIVERSITY OF SOUTH FLORIDA
Tampa, Florida

H. Edwin Steiner, Jr.
EDU 308, Mathematics & Science Education
University of South Florida
Tampa, Florida 33620
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PROGRAM DESCRIPTION (Preservice, In-service):

This course, "Trends in Teaching Secondary School Biology," is designed primarily for prospective or beginning teachers of secondary school biology. The main factors influencing its development are:

1. The need to individualize instruction due to student differences. The course has been individualized to allow for these differences and for self-pacing through the use of learning modules or packets. These modules are revised regularly on the basis of student performance and feedback.

2. The need to provide a type of learning experience or approach to teaching different than any others experienced by the students. This would thereby provide experience with an alternate teaching approach which students may use in their teaching.

3. Students should know from the beginning of the course what they are to accomplish. Performance objectives are specified and the student knows which and how many behaviors he must demonstrate in working toward the grade he hopes to receive.

4. Students' learning experiences include use of media and techniques which they should use in teaching biology.

5. To determine the most effective approach for such a course when the class is scheduled to meet one night per week.

These factors led to the use of learning modules. Each module is designed to develop a competency needed by secondary school biology teachers. Each module contains a flowchart for sequencing experiences; an introduction with performance objectives specified; and pretests (so student may proceed to another objective or module if he already possesses the competency). These modules are given to the student at the beginning of the course with an explanation of the general operating procedure.

As indicated earlier, an effective approach for teaching this course when it is scheduled to meet one night per week is being investigated. The course has been revised, based on one term's experience, to include a session of the entire class each scheduled class period for about one hour. Following this, students may proceed individually with the module of their choice. They may

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
An understanding of basic ecological principles that should be included in a secondary school biology course and an understanding of outdoor and classroom activities which can be used to develop desirable environmental goals in secondary school students are essential requirements of prospective teachers of secondary school biology.	Prospective teachers study ecology texts, observe films and attend seminars as needed to acquire knowledge of ecological concepts appropriate for secondary school students. They also participate in field studies which illustrate activities which may be used with secondary school students. Prospective teachers also design and teach a series of learning activities.

→ OUTCOME(S) ⇄ EVIDENCE

From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The prospective teacher: 1. understands the ecological principles which may be learned by secondary students, 2. learns of outdoor and laboratory activities appropriate for students, 3. plans and teaches ecology lessons.	After studying texts and films and attending field studies and seminars, the student: 1. Answers correctly at least 80% of the items on a multiple-choice test of basic ecological principles. 2. Plans and teaches lessons about ecology or the environment which include: a. behavioral objectives b. discovery activities c. valid evaluation d. analysis of results and teaching.

TABLE:

MODULES, GOALS AND OBJECTIVES for
"Trends in Teaching Secondary School Biology"

MODULE	GOALS THE STUDENT WILL DEVELOP	OBJECTIVES*
History and Nature of Science	Understanding of science and its historical development	R and O
Processes of Science	Understanding of science processes and ability to design an experiment	R and O
Curriculum Materials	Knowledge of materials for teaching biology and how to use them	R
Periodicals for Teachers of Biology	Understanding of helpful journals and of ideas for the classroom and laboratory	R
Planning for Teaching	Ability to prepare lessons which include concepts, objectives, discovery activities and valid evaluation	R
Strategies for Teaching Biology	Understanding of various techniques for different topics and situations	R and O
Ecology	Understanding of ecology principles and of outdoor and classroom activities with emphasis on the environment	R and O
Teaching	Application of teaching skills and methods	O
Recent Issues Science Teaching	Understanding of main topics of concern among science educators	O
Your Thing	Competency in an area of biology teaching of his choice	O

* R - required; O - optional

also work in the laboratory, and interact with the instructor at other times during the week.

The first time this course was offered, no sessions of the entire class were held. Students were free to work when they chose. The instructor was available to students for the entire period each week when the class was scheduled. Student performance, however, was unsatisfactory. Student feedback suggested that the most likely explanation was that students perceived that they needed more whole class interaction in which the class, under the instructor's guidance, could engage in activities related to the topics of the modules of the course.

Subsequently, the second offering, now in progress, includes a class session each week for a part of the scheduled time period. The evaluation of this modified individualized approach is not yet complete. However, observations suggest that students are achieving the objectives satisfactorily and that they have a much more favorable perception of the course and its benefit to them.

AVAILABLE MATERIALS:

None listed.

HOFSTRA UNIVERSITY
Hempstead, New York

Jerry B. Davis
Hofstra University
Hempstead, New York 11550
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PROGRAM DESCRIPTION (Preservice, In-service):

One among several noteworthy features of the secondary school science teacher education program is that students may select as their first course in education a course titled, The Secondary School Teacher, which is performance centered. The course includes weekly observation and participation in a secondary school in addition to a college class. Thus a student in his sophomore year or a beginning graduate student with no prior course work in education is immediately placed in a secondary school. The observation and participation is scheduled for at least two consecutive periods, once a week for the entire semester. The student engages in numerous activities, instructional as well as other types. Successful accomplishment of the various teaching tasks may be credited toward the student's grade. In the college classroom, activities are centered around various tasks that relate to teacher performance. Some of these tasks include formulating behavioral objectives within various categories of Bloom's taxonomy, preparing lesson and unit plans, developing a learning activity package, presenting a mini lesson, etc. Grades are determined upon the number of tasks chosen and successfully completed by the student. Certain tasks, however, are required of all students.

Another noteworthy feature of the program is the continuation of secondary school observation and participation while the student is enrolled in the science methods course. The college class work is performance centered. The objectives of the course are presented in student behavioral terms. Activities include presenting mini lessons, formulating a plan for an inquiry lesson, etc.

During student teaching, the student also enrolls in a course in classroom analysis. He learns various systems for analyzing interaction. He tapes his own teaching, objectively codes and analyzes his teaching behavior, and determines the patterns to continue to reinforce, modify, eliminate, and develop. He plans strategies to accomplish his goals and continues to analyze his teaching to measure changes in the directions cited.

These are just a few of the features of the secondary school teacher education program. This is not intended to be a description of the entire program; only a description of some of the elements related to a teacher performance based program.

AVAILABLE MATERIALS:

Course Outline for courses described. (Free)

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
The application of learned systems of analysis may lead one to identify patterns in one's teaching that one may choose to eliminate, reinforce, modify or develop.	Students tape their own teaching. They analyze their teaching, employing systems of their choice (e.g. Flanders, VICS, Gallagher-Aschner, etc.) They identify patterns of behavior to eliminate, modify, or reinforce with supporting rationale. Students plan strategies to bring about desired changes. Students employ the systems of analysis to determine the degree of change over a period of time.

→ OUTCOME(S)	⇄ EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Upon reviewing their lessons via tapes the students will employ a system of their choosing and analyze the lessons. They will identify desirable and undesirable patterns with reasons to support their choices from educational and psychological theory or research findings. They will design ways to bring about changes in their teaching patterns.	Students will submit tapes or typescripts of several of their lessons spaced several weeks apart. In addition, students will submit analyses of their teaching with patterns identified for modification and compare changes from one lesson to another indicating changes in the directions cited by the student.

SOUTHERN ILLINOIS UNIVERSITY
Carbondale, Illinois

Helen H. James
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Southern Illinois University
Carbondale, Illinois 62901
(Telephone: 453-2239)

PROGRAM DESCRIPTION (Preservice):

At the secondary level our science teacher preparation program might be termed "cafeteria style." One exception is that there are two general dishes in the appetizer section which must be chosen before other alternative "science" courses will be served.

Following an introductory course in educational psychology and one in principles of secondary education, our science majors begin a three quarter program which allows various alternatives in areas we might broadly categorize as knowledge, practice, and application.

During their first quarter in this sequence, they begin a course called "Methods of Teaching Science in the Secondary School." Initial assignments are class oriented and teacher directed. The student has alternative methods open to him along the route to pre-set objectives. Later experiences become increasingly individualized with both topic and method chosen by the student. Grading is on a total point system. The student chooses the type and number of experiences desired. The final experience is development of an instructional design of the student's choice. One experience from that unit design is taught to the class with materials which they have designed. The objectives for this instruction are set by each student and the combination of design, material, and teaching performance is his "final examination" or culminating product for the course. All experiences are "contracted" between student and teacher, and between student and peer evaluator. A separate proposal, stating objectives, tasks, products, completion date, and point value expected is submitted for each contract. A simplified "proposal-contract" form is supplied by the instructor. Signatures of the investigator, peer-evaluator, and instructor are affixed before filing in the student's folder to await project completion or renegotiation. Emphasis is continually given to peer and self-evaluation as well as instructor evaluation.

The following types of experiences exemplify a few alternatives for the course from beginning to end:

1. Define science and the scientific enterprise empirically. (class project)

2. Choose any major curriculum project and investigate its philosophy, objectives, texts, and supporting materials. (group project)

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
A teacher's definition of Science (What it really means to him) affects not only what he will teach, but the way he will teach it.	Teacher candidates gather data about "What science is" from many sources including a survey of community scientists and non-scientists. All information is reported, organized, discussed and distilled.
Unless a science teacher becomes responsible for his own learning it seems unlikely that he will guide his students in becoming responsible for theirs--Where, then, are future independent thinkers and "fluid enquirers?"	Students contract for various projects of their choice. They choose from partially organized topics offered by the instructor, or propose endeavors which will help them in preparing to teach science, Most finished projects are evaluated by a peer, by the instructor, and by the student himself.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. Each student is responsible for synthesizing a definition, or choosing one from the class data, which is functional and compatible with his understanding of the nature of science.	1. Upon viewing video tapes of actual science classes they are expected to broadly evaluate whether science and the scientific enterprise are truly represented as they have defined them. They will then support their judgment with examples from the tape.
2. Each candidate identifies with that definition as he proceeds to experience and plan for science education at the junior and senior high level.	2. They plan and peer-teach short lessons which are videotaped. One criterion for evaluting those lessons is the degree to which they are representative of the nature of science as they have defined it. 3. Each candidate develops a "six week" instructional design for teaching a science topic of his choice. One basic evaluative criterion for this "term project" is whether it is consistent with the nature of science as expressed by his functional definition - (by this point in time it is almost his badge.)
1. Students equate choice, needs and interests with assignments, projects, and class work. 2. Each student becomes guardian of his own progress through choosing what he will study, pacing himself, evaluating self and peers, offering proposals, living up to contract deadlines, and finally calculating and recording his own grade.	Each component is self-evident - more happily or painfully to the student than to the instructor. As the quarter progresses, the procrastinator learns about freedoms, responsibility and consequences. Frustrations give way to independent endeavors. When grades are calculated there is no doubt about giving-receiving- or learning!

3. Choose any two area schools and observational visits will be arranged for eight visits to four science classes over an eight week period. (small group project with observational guidelines packet)

4. Using a programmed guide, appraise any text and lab book available for your subject field--about forty titles are available in our center. (individual project)

5. Read anything you wish concerning learning and teaching, and submit abstract cards which include your response to the article or book. (individual project)

6. Develop a series of lessons on topics of your choice to practice the following discussion skills: Reinforcement, probing questioning, high order questioning, etc. (a video, micro-teaching project lasting three weeks--class-group-individual responsibilities)

7. Develop a presentation using any media you desire to facilitate learning on a topic of your choice and teach it to your class or to a high school class--instructor makes arrangements. (individual or team project)

etc., etc. ...

During the second science education quarter, a student may elect to serve as a "science intern" in one of many classrooms near campus. There he participates in the ongoing classes as an aide or small groups learning guide. Sometimes he is a team member indistinguishable from any other adult who is labeled "teacher" for most class activities. The student decides how many hours he can devote to this experience and the college credit varies accordingly, from four to eight quarter hours.

Finally, a quarter as full-time teaching associate is experienced. Throughout the three quarters, students can work with the same university faculty member or team.

The program described above has been piloted for two years. Beginning in September of 1973 several innovations are planned. They do not change the program goals or experiences greatly, but do allow more alternatives for specific needs, intensity of experience, and sequence of topics.

1. On campus course work will be offered in short modules to be completed independently of each other.

2. A modular series of "teaching skills" will be offered as a micro-teaching laboratory course.

3. During each quarter for four quarters, the student will be increasingly involved in the act of teaching. Beginning with observation throughout a quarter, he then becomes a one day per week aide, and during the third quarter he will be in an area school designated as a center. Here he spends one-half of each day in science classrooms and the other half in his own professional classes taught at the center. During the fourth quarter he is full-time teaching associate.

6. Evaluation becomes even more highly competency based as tasks within specific modules and practical experiences are defined.

AVAILABLE MATERIALS:

Textbook appraisal guide - self instructional packet with objectives.

Classroom observation guide - for student observers in the public school science class.

Video tape - class discussion using probing techniques and higher order questions (10 minutes). Furnish blank tape plus $10.00 for duplication and shipping.

Video tape - (actual high school chemistry classroom) "Periodic Law and the Nature of Science" (50 minutes). Furnish tape and $20.00 for duplication and shipping.

For materials write to: Helen H. James
323 Wham
Southern Illinois University
Carbondale, Illinois 62901

UNIVERSITY OF IOWA
Iowa City, Iowa

V. N. Lunetta
W. Sharp
Science Education
University of Iowa
Iowa City, Iowa 52240
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PROGRAM DESCRIPTION (Preservice):

During the initial phase of the course, we examine some basic concepts relating to the structure of science, the tentativeness of scientific information, and the meaning of inquiry and its role in the teaching of science -- through laboratory activity.

The role of "teacher" is defined within the context of our current understanding of the nature of the learner and the learning process.

In this section of the course, we will experience modes of instruction and learning which are different from the traditional lecture and demonstration mode. These methods will include: student involvement through laboratory and inquiry techniques, individualization through contracts, audio-tutorial, programmed instruction, simulations and gaming, and computer assisted instruction. As a conclusion to the section, student teams will design and build an individualized self instructional module. The module will be designed to familiarize other students with one of the "Nuts and Bolts" topics or to supplement a science course in the student's area of interest. This activity will constitute one of the major project assignments for the course.

A major objective of the course is to have each student develop a thorough understanding of the historical development and philosophical underpinnings of one national science curriculum project in his specific content area. New curricula will be surveyed at all levels (kindergarten - twelve) with special emphasis on grades seven through twelve. Programs covered will include those developed for students with learning and motivational difficulties.

The major project within this phase of the course will be the development of a short teaching sequence suitable for presentation to a high school or junior high class. This teaching "package" will incorporate the philosophy, teaching strategies, and instructional materials commensurate with the specific curriculum project under study. During this phase of the course, students will visit classrooms, and by utilizing their project material, will work closely with a classroom teacher and students.

Students will be familiarized with "Nuts and Bolts" issues, primarily through individual interactions with the audio-tutorial units and supporting materials designed by student teams. "Nuts and Bolts" topics will include, but not be limited to, the following:

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Teacher candidates should have an understanding of processes underlying learning. They should have first-hand experience in dealing with these processes through the development of a self-instructional module.	Teacher candidates design and construct an individualized self-instructional module. The module is designed to supplement a science course in the student's area of interest.
Teacher candidates should have a thorough understanding of the historical development, philosophical structure, and content of one national science curriculum project in their major area of interest. They should comprehend the evolution of instructional strategies culminating in current concerns regarding self-pacing, contract-teaching, activity-centered study, etc.	Teacher candidates prepare laboratory activities representative of their projects and use them in role playing environments with peers. They work for a time in classrooms where the materials and new instructional strategies are employed. They prepare and run a teaching/learning sequence which incorporates the philosophy, teaching strategies, and instructional materials commensurate with the curriculum project under study.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The candidate becomes familiar with the problems of task analysis and must produce statements of objectives for a particular unit. He grapples with the various means of attaining the stated objectives, and he then produces materials designed to help a student attain these objectives. The candidate produces a module which he uses with students and which is an individualized supplement to an existing course.	The module produced is used effectively in teaching peers and subsequently in a real classroom environment. During peer teaching, evaluative critiques of the module are an integral part of the development process.
The candidate recognizes the implications of the curriculum project under study through interactions with teachers and students and through particular curriculum materials.	The role playing and classroom teaching sequences are implemented effectively. Evaluative critiques by teachers, students, and peers are incorporated in all phases of the program.

Behavioral Objectives - Cognitive & Affective Domains
Evaluation of Students
Testing Techniques
Programmed Instruction
Developing Independent Student Projects
Animals in the Classroom
Science Teaching & the Law
Laboratory Safety
Science Clubs
Classroom Management
Ordering Lab & Classroom Materials
Operation & Politics within School & Science Department
Homework
Professional Organizations
Professional Improvement

The last section will include a critique and evaluation of the effectiveness of each audio-tutorial unit.

This preservice course is normally followed by student teaching.

AVAILABLE MATERIALS:

None listed.

LOCK HAVEN STATE COLLEGE
Lock Haven, Pennsylvania

Donald L. Oakley
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Lock Haven State College
Lock Haven, Pennsylvania 17745
(Telephone: 717-748-5351, Ext. 306)

PROGRAM DESCRIPTION (Preservice):

The Lock Haven State College science teacher preparation program accounts for all the pre-student teaching education experiences including competencies in audio-visual and communications work, educational psychology, social foundations and methods in science education. These areas are all taught under the umbrella of a single ten semester hour program over a two semester period during the junior year. The science education professor acts as content area specialist and coordinator of the entire ten hour sequence. The full program is planned by the team leading toward achievement of competencies which prepare candidates for the student teaching experience. The student teaching experience is evaluated by comparing performance against a list of teaching competencies developed by the education staff. Science methods instruction prepares the student for fulfillment of these competencies and is based on a developing series of competencies for the pre-student teaching portion of the program. Specific topics, skills and experiences in the various areas mentioned above are planned to fit in with the basic science methods instruction and are taught by the specialists at the call of the coordinator.

The core of the competency based program of student experiences is centered on a sequence of microteaching experiences, increasingly exposing the methods student to more advanced instructional skills as the year progresses. Generally seven or eight microteachers are used to check the candidate's ability to perform in increasingly student centered situations. Microteach competencies begin with information presentation skills such as lecturing and demonstration techniques and lead to more student active lessons in which discussion and inquiry are emphasized. In each lesson, the pre-service teacher is videotaped in a classroom situation, teaching four to five students who are real learners. The advantages of this low risk and low threat situation are important in the candidate's early work and initial experiences. The lesson is observed by the science methods coordinator and evaluated with the candidate thereafter. Methods instruction is agreed toward development of the skills to be used in each successive microteach.

During the second semester, the candidate is matched with a student from a local high school in a tutoring assignment. The students are chosen to need assistance in the content area of the pre-service teacher. This gives further contact with real learners and provides an additional experience in a semi-instructional setting. The tutor work is used by methods, educational psychology and social foundations specialists to provide raw data and real experiences on which to base further instruction. In concentrating on a single student, the candidate can carefully consider how to individualize instruction

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
To properly teach science, the learner must be actively involved in doing science, especially investigating, interpreting, correlating, etc. i.e. those items closely associated with the processes of science.	Teacher candidates are placed in actual instructional situations in which specific instructional skills are required. As candidates progress, increased emphasis is placed on skills which involve students thinking and doing in the classroom. Discussion and inquiry skills are emphasized.
The candidates use technical photography as a means of gaining information about the world in which they live, applying this information to formulate or verify relationships therein.	Candidates are presented with the problem of teaching a concept using photography as a "best vehicle." Stress is placed on choice of instructional concept to best use the strengths of photographic methods.
In teaching science, the candidates must recognize social background and psychological factors as significant influences on the needs of students and the direction of instruction for each student.	Teacher candidates engage in instruction and social interaction with a single learner over a period of several months. Emphasis is on assistance in subject matter areas and service as an adult model in social behavior.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Candidates gain skills in higher order instructional practices which center on the learner. They become critical of traditional lecture information passing as a way of life and strive to have students be active investigators and evaluators of data they study or develop.	Candidates increasingly use student centered activities and discussions as instructional vehicles in instructional situations.
Candidates produce usable instructional materials and packages for their own future use and revision. The utility and advantage of data gathering via photographic technique is an important realization.	Students select photographic solutions to instructional and data gathering problems when appropriate.
Candidates relate social background and psychological factors to the problems of selecting and using instructional material.	Upon being confronted with a learner problem, candidates will go beyond the subject matter and search for possible learning blocks which may be socially or psychologically based.

and more completely understand the problems, both social and academic, students face on a daily basis.

Several more conventional aspects of methods instruction are retained, including concentrated work on performance objectives, unit planning, evaluation of students, lesson preparation and school observations including limited teaching assignments. It is believed that the student teaching experience should be the place where candidates get extensive experience under careful guidance of cooperating teachers.

A rather valuable portion of our teacher preparation deals with basic photography skills and their use in science instruction. After early work learning to use common communication hardware, students are introduced to the fundamentals of photography including useful skills in copying, micro- and macro-photography and captioning. At this point they are asked to prepare a learning experience using some aspect of photography as a teaching tool. Results have varied from sequential microphotographs used in gathering data on flower development to a slide-tape instructional unit on laboratory techniques in chemistry. Emphasis is placed on photography as a communication technique especially useful in science instruction.

AVAILABLE MATERIALS:

None available currently.

UNIVERSITY OF MAINE
Orono, Maine

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206 Shibles Hall
College of Education
University of Maine
Orono, Maine 04473
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PROGRAM DESCRIPTION (Preservice):

In the College of Education at the University of Maine (Orono), a program of general curriculum development for undergraduate teacher preparation is now in its second year. The overall goal of the program is both to change the delivery system of courses and to gradually move to a competency-based curriculum. To date, two courses in Educational Foundations are available as a series of five week modules, each taken for one semester hour of credit. In addition, the secondary science methods course and the secondary social studies methods course are in the process of modularization.

In the secondary science methods course (ED M 142) the student still registers for a three credit course, which has a traditional schedule: two meetings per week each of two hours duration. In actuality, the whole class meetings are only infrequently used. The course is administratively divided into three five-week modules and also has one additional module available on election for honors grades. The three standard modules are entitled: Module I: Foundations of Science Education, Module II: Science Teaching Techniques, Module III: Science Education in the Laboratory.

Module I. The foundations module features a review of foundations course work with special application to science teaching. Since students who enroll in this course have had little exposure to individualized instruction, the first two weeks of instruction are of the lecture/discussion variety. Topics for discussion are: the nature of science and science teaching, educational philosophy and psychology as applied to the teaching of science, the roles of the teacher and typical methods of instruction. The remaining three weeks of the module feature work on planning lessons. This work is individualized and is directed by cassette tapes and printed handouts. Efforts in the design of the planning activity were directed towards forcing the learner to completely structure lessons in great detail.

Module II. The teaching techniques module has a two-fold set of requirements and is completely individualized. As a general assignment, students are required to develop an audio-tutorial unit of instruction including the actual production of cassette tapes, video tapes, 35mm slides as well as other necessary material. To get ready to produce the audio-tutorial unit, students use tape and display materials to acquire additional skills. These include: conceptual analysis, development of invitations to inquiry and classroom games, analysis of learning materials, use of audio-visual equipment, development of

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Students plan a group of lessons which clearly specify the procedures to be employed	Students use an audio-tutorial tape along with a series of handouts in which they are given a "mental set" of what should be in a "good" lesson plan.
A concept is acquired by a learner in a sequence from sensation to generalization.	Students use an audio-tutorial tape which directs their analysis of a text book and accompanying laboratories to determine conceptual development.
Laboratory work done in the secondary school should be carefully evaluated by the teacher prior to use.	Students debug a unit of laboratory work given in one of the NSF sponsored programs such as IPS, ESCP, BSCS, etc.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Lesson plans include required detail.	The plans themselves can be inspected from a set of objective specifications.
Students are able to classify concepts and evaluate a text development for completeness of conceptual development.	Student-made evaluations can be judged against a list of specifications.
Students are able to find "problem" areas in laboratory work and specify appropriate remedies.	Student-made evaluations can be judged against a list of specifications.

questioning techniques, production of tests and quizzes and examination of sources of teaching procedures such as teachers' sourcebooks.

Module III. The laboratory module includes both formal classroom instruction and individualized work. In the formal portion, three presentations are given which are in the areas of: the major school science programs (IPS, ESCP, BSCS, CHEMS, HPP, etc.), laboratory maintenance and safety, laboratory design and ordering equipment and materials. The individualized portion of the module requires the student as a member of a team to conduct the laboratory component of one unit of one of the "newer" programs. Because of a limitation on available equipment, most of the work done is at the junior high school level. In addition to the actual laboratory work, students are asked to read and report on the articles published during the past five years on the program they are investigating, and, to give some attention to the equipment and supplies necessary for the conduct of the program they select.

Module IV (Optional). This module is not time bound and hence may be completed anytime during the semester. The student is required to work in the capacity of a teacher's assistant in one of several schools which have working agreements with the university. The minimum requiement is for the student to spend the equivalent of two weeks in the school and to provide the teacher with a specific type of service. Some students plan and conduct units of their own design, others assist in the laboratory while others work with students who need special help. The cooperating teacher is asked to evaluate our student's work during this module.

Evaluation of students' progress in the course is of several types. In general, specific objectives of each of Modules I through III are rated against a bill of specifications and are listed in the student's file as passed or not-passed. If a student passes all of the objectives of these modules, he is awarded the grade of B. Should Module III be completed the student is given an oral examination which is a simulated job interview. Successful students for all requirements listed above are awarded the grade of A. Grades of C and below are given as a result of negotiations between instructor and students.

The contents of each module have been listed in terms of the objectives intended. At the close of each modular period students are asked to rate the module both in terms of their perceived achievement and in terms of the relevance of each objective to them. This ongoing method of evaluation is being used to add and delete objectives for the various modules as well as to develop new modules.

Plans for the future include the extension of credit for the course from 3 to 8 semester hours. The exact number of semester hours or modules taken will be determined by the student. The school involvement module (Module IV) will be moved into the sophomore year and will be repeated again during the junior and/or senior year. Plans are now being formulated to break down the interface between this course and student teaching as well as the modularized foundations offerings. These changes are being pursued in the hope that a continuous progress, criterion based program will evolve.

AVAILABLE MATERIALS:

Syllabus and Handout materials for ED M 142 at the University of Maine at Orono (Free).

MARS HILL COLLEGE
Mars Hill, North Carolina

L. M. Outten
722-C
Mars Hill College
Mars Hill, North Carolina 28754
(Telephone: 704-689-1188)

PROGRAM DESCRIPTION (Preservice):

Course Outline:

Background: Aims, Objectives, Emphases
Types of Courses
Teaching Procedures, Methods of Presentation
Psychological and Sociological Foundations
Learning Theories
Content, Themes, Objectives, and Emphases
Approaches, Inquiry Strategies and Techniques
The Investigative Experiment
Laboratory Procedures, Demonstrations
Observation of Teaching Procedures in High School Science Classes
Organizing Materials, Developing Units of Study, Preparation of Lesson and Teaching Plans
Presentation and Development of Teaching Plans
Preparation, Presentation and Development of Laboratory Teaching Plans.
Preparation of Teaching Units
Materials and Equipment for Teaching Sciences
Audio-Visual Materials, and Equipment as well as Procedures for Teaching Sciences
Use of Natural and Living Materials in the Classroom and Laboratory
Field Studies, the Natural Environment in the Sciences
Special Techniques Useful in Teaching the Sciences
Class and Laboratory Tests for the Sciences
Organizing Instructional Media
Selection of Textbooks, Reference Materials
Journals and Current Materials
Supplementary Reading Materials
Related Sciences Needed in Biology: Chemistry, Biochemistry, Physics, Statistics, Geology
Evaluation
Trends in Recent Biology and Science Curricula, Innovations, Issues
Facilities and Equipment for Teaching the Sciences including Biology
Professional and Scientific Journals
Professional and Scientific Societies
Beginning Teaching
Professional Improvement and Growth

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Careful planning is essential for effective teaching.	1. Teacher candidates submit topics for unit plans. 2. Teacher candidates collect information and materials for the resource unit. 3. Teacher candidates organize the resource materials in detail. 4. Teacher candidates prepare written lesson plans. 5. Teacher candidate presents and develops his lesson plan with the class as his "students." 6. Teacher candidate prepares, presents, and develops another lesson plan of which a tape recording is made, later played back, and analyzed. 7. Teacher candidate prepares, presents and develops an additional lesson plan of which a videotape recording is made, played back, and analyzed.
Practice in actual teaching situations provides helpful experience.	1. Teacher candidates may help with teaching activities and instruction as laboratory and teaching assistants. 2. Teacher candidates may help as individual or small-group tutors for students needing additional assistance.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The candidate learns with guidance, practice, and experience having opportunities for correction and improvement of procedures.	Improvement in the ability to plan, organize, and develop units as well as lesson plans.
Teacher candidates learn the importance of adequate preparation, interest, receptivity, understanding, conceptualization, identification, association, participation, and application in the learning procedure.	Improvement in the understanding of learning and the development of skills in teaching.

- Desirable Classroom Management, Teaching, and Professional Relations
    - Discipline
    - Motivation
    - Emotional Adjustments
    - Individual Differences
    - Personnel Adjustments
    - Important Considerations in Teaching the Sciences including Biology
    - Student Teaching Adjustments
- BSCS and Other Special Studies and Publications
- Sources of Needed Materials
- Career Opportunities in Biological and Other Sciences
- Research in Biology, Biological Education, and the Other Sciences

AVAILABLE MATERIALS:

None listed.

UNIVERSITY OF MARYLAND
College Park, Maryland

John W. Layman
Science Teaching Center
College of Education
University of Maryland
College Park, Maryland 20742
(Telephone: 454-4028)

PROGRAM DESCRIPTION:

The University of Maryland Science Teaching Center offers preparation for science teaching in all areas of science and at all levels from kindergarten through college. The staff consists of Elementary Science Specialists associated with Early Childhood and Elementary Education and Secondary-College Science Specialists each holding a joint appointment between Secondary Education and one of the science departments (Botany, Chemistry, Geology, Physics and Zoology).

As one of the state institutions offering majors in each of the sciences, the Center also complements these areas with teacher preparation programs. Students involved in the program include those majoring in one of the sciences who know that they wish to teach when they arrive at the university, and many others who decide this after they are well along in their science programs.

Although the potential job market for teachers is limited, well prepared teachers in science are still finding positions at the junior and senior high school levels.

Upon graduation each student should exhibit through appropriate behavior:

a. bachelor degree level competency in a science.
b. introductory level competency in the other areas of science.
c. beginning competencies in the philosophy and foundations of education.
d. beginning competencies in learning theory and the nature of the learner.
e. beginning competencies in the philosophy and methods of teaching science.
f. beginning competencies in the conditions for teaching in various school settings (Urban, rural, suburban, etc.)
g. an awareness of a variety of teaching styles.
h. beginning competencies in the conditions for utilizing various teaching strategies (self-paced, audio-tutorial, investigative, etc.).
i. beginning competencies in teaching science at the junior high level.
j. beginning competencies in teaching science at the senior high level as attained in an eight week student teaching experience. (Four weeks half day and four weeks with a full teaching responsibility)

An experiment is now being tried with the prospective chemistry teachers. During the second semester of their junior year and the first semester of their senior year, students spend one afternoon per week for four weeks in each of four classroom settings. The settings are chosen to provide a variety of

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Alternate Experiences Program.	Prospective chemistry and eventually all science education students will, during the second semester of their junior year and the first semester of their senior year, spend one afternoon per week for one semester in each of four settings (urban, suburban, rural, etc.) observing a variety of programs (Chems, IAC, etc.) and a variety of teaching styles.
Full semester student teaching experience.	Each student will spend the full semester in the student teaching setting. There will be eight weeks of one half day sessions in a junior high and a combination of four weeks - one half day sessions and four weeks of full teaching responsibilities in a senior high setting.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Since students participate in at least four settings with a variety of programs and teaching styles, each should become aware of the importance of developing an individual style and capitalizing on individual strengths, personality factor, the physical setting, and the nature of the students. A student has a much better chance to determine before the actual student teaching semester, which setting may be most suitable or perhaps that teaching is not an appropriate choice of profession.	A greater number of students will indicate choices in setting, program, and teaching style, for their student teaching assignment, and be able to defend the choice. Others may choose not to continue in the program.
Each science education student will have had experience at two levels of teaching. The problems discussed in the general education and special methods of teaching science courses may be discussed in the context of the actual classroom experience rather than in a theoretical setting. Students will have had extended experience with two levels of students and different types of courses.	Many of the problems in science education will be discussed by the students from the perspective of both junior and senior high students and courses. Students should have less difficulty finding jobs. Students should spend less time criticizing the junior high science teacher for things not known when the students arrive at the senior high. A better rapport should develop between teachers at the two levels.

experience for the students in terms of the type of school (urban, suburban, etc.) varieties of programs being offered (Chem, IAC, etc.), and styles of teaching (conventional, self-pacing). These experiences provide guidance in selecting an appropriate setting for the student teaching experience or in discovering before the final semester, that teaching would not be an appropriate career choice. This program will be expanded to other areas of science and is a part of a proposed restructuring of the secondary education course.

In a major change in our student teaching program, all students in science now spend sixteen weeks student teaching, eight weeks of half days in a junior high and eight weeks in a senior high setting. The last four weeks of the senior high assignment involve a full teaching load.

All of the topics and problems presented and discussed in the general and science methods courses, taken concurrently with the student teaching, may now be discussed in the context of the student's actual classroom experiences. The general methods course is heavily based on modules (i.e. communication, interpersonal relations, evaluation, professionalism, management, etc.). The science methods course focuses on competencies of an effective science teacher.

Employment prospects for students who have had both a junior and senior high experience are enhanced, and some of these students discover that science teaching at the junior high level may be very rewarding and is very much needed.

AVAILABLE MATERIALS:

None listed.

UNIVERSITY OF MINNESOTA
Minneapolis, Minnesota

Clarence H. Boeck
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University of Minnesota
Minneapolis, Minnesota 55455
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PROGRAM DESCRIPTION (Preservice):

University of Minnesota students preparing to be secondary school science teachers are enrolled in the College of Education for their junior and senior years. Formerly all education students were required to take two five-credit courses in education during their junior year. One course dealt with sociological, and the other with psychological, foundations of education. The "methods" courses taken during the senior year consisted of a three-credit, fall quarter increment followed by one-credit courses in the winter and spring quarters. Students had their first classroom experience during the senior year as student teachers.

Students in the psychological foundations course complained that the material was irrelevant, while instructors of methods courses complained that students lacked background which they assumed had been taught.

During the 1969-70 school year, a new six-credit course which combined the content from the five-credit introductory educational psychology course with selected content from the five-credit science methods sequence was introduced. The class met for two consecutive hours five days a week concurrently with two sections of the seventh grade science course in the neighborhood high school. The pupils from these sections were continually available for observation and as subjects for microteaching sessions.

The content, organization and activities of the course were selected with the following assumptions in mind:

> There should be early work with high school pupils to provide an opportunity for career choice evaluation;
>
> Course work in education should become more meaningful after classroom experience;
>
> There should be early identification with teaching and pupils as well as with the academic subject field.
>
> Combining educational psychology, science methods, and classroom experience should make a highly relevant package.

The course has used both team-teacher instruction and instruction using only science education professors who have up-to-date educational psychology backgrounds. The team-teaching in this combined course was provided by an instructor of educational psychology with a science education background and a professor of science education. In addition, the seventh grade science instructor served as an observer and feedback-resource person during the micro-teaching phases.

Class discussions, initiated by student-developed definitions, resulted in the formulation of a working definition of science, and this, plus the ways in which this definition could be implemented in the classroom, became the framework for consideration of such topics as reinforcement theory, behavioral objectives, motivation, attitudes, and grading practices. The course activities included discussions, observations, films, readings, and a series of "micro-teaching" experiences with pupils from the high school.

Micro-teaching in the course was a modification of the concept as developed at Stanford University in which all dimensions of the teaching situation were scaled down to reduce complexity. Each student taught four to eight pupils a 10-20 minute lesson while observed by a faculty member and his peers. No attempt was made to fit these lessons into the seventh grade science course. The teacher of the seventh grade classes considered these periods to be "intellectual holidays" for his pupils.

Each college student was provided with eight or more contacts with the seventh grade pupils during his quarter in the course. Because only three rooms were available to use as micro-teaching stations, a variety of schedules resulted when student enrollments varied. The most sought-for pattern involved teaching on one day, securing feedback from observing faculty and peers the next, and re-teaching a new group of pupils the third day. In some instances, the series of three lessons and re-teachings were so closely related as to constitute a mini-unit. When enrollments were small, this was possible but not essential. With the enrollments greater than fifteen, the re-teaching was not possible and the students simply built a mini-unit which they taught to the same pupils over the course of two weeks. In instances of low enrollment (under ten) it was possible to assign teaching of a sort which the students felt was more realistic -- a full class for half a period, or better, a half class (about 12) for a full 40-minute period. This was in addition to the micro-teaching.

Duplicates of critiques of the micro-teaching were written by peer observers and faculty observers. One copy was given to the student who taught; the other was filed for later review if needed after the feedback sessions. Video taping was provided for at least one micro-session. Audio tapes were made daily with each student recording each lesson on a tape cassette provided. He was expected to review these recordings daily, especially to seek out and concentrate on some aspect of his classroom behavior for improvement. A report of this effort was turned in to the instructors in charge.

Teaching topics were assigned in order to reduce the waste of time and effort resulting from the seeking and rejection of topics before the final selection by the students. This time was better spent in preparing for the teaching. Topics were chosen from the physical sciences because these areas were found to allow for ready demonstration and high level questioning and were readily adaptable to the short teaching period. Topics were short and to the point such as: "the primary additive colors are green blue and red," or "like static charges of electricity repel while unlike charges have an attractive force." The physical science topics were especially desirable because the seventh graders were studying life science and the topics were, therefore, quite new to them. Response to the teaching was generally enthusiastic. The seventh grade pupils were cooperative and interested, and they learned about subjects they would not have encountered otherwise. Their teacher, however, suggested that pupils should not be involved for more than two quarters of the academic year.

Students were asked to make daily entries into a logbook which was collected several times during the quarter and read by the faculty. The log served as a place to record insights and reflections about the course, its material, its methods, and its instruction. Students were extremely candid in their remarks and provided feedback regarding the sequence and choice of activities and readings as well as information on the mannerisms, strengths, and weaknesses of the instructors. Communication was not one-way, however, for faculty comments were added to the logs, particularly when they were requested by students.

Multiple-choice examinations were administered in all sections of the educational psychology course to measure the attainment of cognitive objectives. None of the students from the experimental pattern scored as low as the median score of the students enrolled in all other sections. Students have reported that they feel very secure in their first student teaching as a consequence of their contacts with pupils in a teaching situation during the junior year.

AVAILABLE MATERIALS:

None listed.

UNIVERSITY OF NEBRASKA
Lincoln, Nebraska

Donald W. McCurdy
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University of Nebraska
Lincoln, Nebraska 68508
(Telephone: 402-472-3151)

PROGRAM DESCRIPTION (Preservice):

The science teacher education program at the University of Nebraska at Lincoln is basically divided into two portions. The science content and laboratory skill development is primarily the responsibility of departments within the College of Arts and Science. The teaching and curriculum competencies of science teachers is handled by a competency-based teacher education program administered by the Departments of Secondary Education and Educational Psychology and Measurements. The project is entitled NU-STEP (Nebraska University Secondary Teacher Education Project). The NU-STEP Project can best be described as having seven fundamental characteristics which will be described in this paper. It is basically an attempt to apply a more systematic and coordinated approach to the professional segment of the preservice teacher education program.

Collective Planning and Decision Making is the first of these seven Characteristics. The NU-STEP Project is under the control of a Coordinating Committee with representation from both departments involved. Curriculum development is the responsibility of a Curriculum Committee with representation from each academic area within the Department of Secondary Education and from learning theorists from the Department of Educational Psychology and Measurements.

The staff is organized into instructional teams designed to provide for balance in expertise and discipline orientation. The instructional teams are responsible for implementation of the curriculum design. They make their own schedules and instructional assignments within the constraints provided by the Curriculum Committee. Plans are underway to provide for membership on the Curriculum Committee by students and practicing public school teachers and to insure meaningful input from these two groups.

The second fundamental quality of the program is Systematic Instructional Planning. Objectives were written in terms of relatively specific competencies or behaviors that beginning secondary teachers should be able to demonstrate. The curriculum is organized into segments called learning tasks which are developed by small teams of staff members. Specific procedures for developing and modifying the curriculum are outlined in a design manual.

The "learning tasks" are grouped into three spirals - so called because of the attempt to provide for a cumulative building of skills to increasing levels of sophistication.

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
An understanding of the process of inquiry in science and the ability to conduct an inquiry lesson.	Prospective science teachers inquire into the process of inquiry during a prolonged discussion with staff and by utilizing selected readings and videotapes. Candidates are given an opportunity to conduct an inquiry lesson with a group of volunteer junior high school students. The session is videotaped and subsequently analyzed.
Characteristic of science teaching facilities which are consistent with the NU-STEP model of instruction and with current curriculum in secondary science.	Prospective science teachers visit in selected schools to observe various kinds of science teaching facilities and observe how they are related to function. They also observe the NSTA sound filmstrip on "Study of Exemplary Science Facilities." Students are asked to set up rough specifications for an "ideal" biology and/or physical science facility.

→ OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The ability to develop a model of inquiry teaching. 2. The ability to identify basic characteristics of an inquiry class. 3. The ability to demonstrate effective inquiry teaching.	The candidate provides motivational "set" in the form of a problem for a microteaching lesson with junior high pupils. The students respond by proposing hypotheses for solution of the problem. The students suggest and conduct ways of testing the hypotheses. The students arrive at a conclusion based on their reasoning and finding.
Students identify trends in science teaching facilities. Students develop a set of educational specifications for an ideal biology and/or physical science facility. Students are able to describe optimal science teaching facilities consistent with the NU-STEP model of instruction.	The set of specifications is consistent with recent trends in flexibility of science teaching facilities and with the NU-STEP model of instruction. The specifications would be suitable for the introduction of any of the recent curriculum development projects.

The first spiral deals with the development of skills that are commonly needed in the behavior repertoire of all teachers regardless of discipline (e.g. the ability to tutor effectively and skill in leading small group discussions). Spiral I is taught on an interdisciplinary basis. The second spiral is devoted primarily to the development of competencies peculiar to science. Both Spirals I and II focus on the applications of learning theory to methodology and practice. Spiral III includes a variety of learning activities which are completely optional and are offered on an interdisciplinary basis. A "menu" of opportunities are provided from which students may select those that are considered most appropriate to their interests and needs. Among the options now available are: long range planning, drug education, environmental education, cultural awareness, and educational philosophies and purposes.

The third basic characteristic of NUSTEP is a greater emphasis on the Relation of Theory to Practice. There is general agreement that teachers in training need more and earlier practical experiences in the schools. In the Nebraska University Secondary Teacher Education Program students spend either one whole day or two one-half days per week in the role of a teacher assistant. This gives them an opportunity to relate their theoretical classwork in learning principles and methodology to a practical school environment. They are thus given an opportunity to demonstrate various teaching strategies and skills generally in a public school environment. We believe that the NUSTEP student can be and should be a valuable asset to the cooperating teacher as that teacher attempts to provide for a greater degree of individualization to his instruction.

Another basic aspect of NUSTEP is the Integration of Courses and Disciplines. Still another criticism often leveled at teacher education is that it tends to be fragmented and repetitious. The NUSTEP program combats this problem by fusing the learning theory course, the methods course, the principles of secondary education course, and student teaching into one, continuous, integrated program. This constitutes 17 semester hours or approximately 75% of the professional portion of the teacher education program. Planning is currently underway for increased involvement of individuals from the academic disciplines in the planning and implementation of the NUSTEP program (e.g. our students presently serve as student assistants in an experimental inquiry oriented botany course and as proctors in a Keller Plan physics course.)

A fifth major quality of the NUSTEP program is that it is Performance Based. The NUSTEP project has a criteria referenced evaluation system in that students in this program are required to demonstrate at least a minimal level of performance in the learning tasks of Spirals I and II. They must do this in some overt measurable way. Much of this is accomplished through microteaching where the participants "teach" each other in small group situations or in schools where secondary school students volunteer some of their study time to serve as pupils. If a student fails to demonstrate a minimum performance level, he is counseled and recycled through alternate learning activities until he is able to exhibit required competence.

Characteristic number six is Flexibility and Individualization in the Instructional Format. Elements of the program that lend themselves to a self-instructional format are placed on auto-tutorial programs that may be checked out and used at the convenience of the student. Other kinds of experiences require small groups of 5 to 15 for a greater degree of individual participation and involvement. Occasionally, it is desirable for these groups to be interdisciplinary in nature in order that a given problem may be examined from the vantage point of several subject matter areas. For example, the problem of general goals in secondary education is attacked from a cross-disciplinary perspective.

The first few pages of Spirals I and II booklets contain competency statements. Students are encouraged to "test out" of various learning activities by providing evidence of at least minimal skill level. Thus many students having previous experiences which qualify them in given competencies may spend a proportionally greater amount of their time on the optional activities available within Spirals II and III.

A greater degree of individualization is provided through a proctoring arrangement whereby from 5 to 15 students are assigned to a staff member for monitoring, supervision, diagnosis, and counseling.

The final and probably the most important aspect of NUSTEP to be described in this presentation is its Evolutionary Nature. During the four semesters of its operation, it has changed considerably and it will continue to change in the future based on feedback received during previous semesters. Information is collected from students at various points during the semester relative to their attitude about various aspects of the program. At the end of each spiral an attempt is made to evaluate the success of the various task elements. Learning tasks are subsequently revised and resequenced prior to their use during the following semester.

Several studies have been completed which were designed to measure the effectiveness of various aspects of the program. The results of these studies have been quite favorable and encouraging. However, many elements of the project need additional research evidence to support their inclusion. Systematic procedures for continuous evaluation and modification of the program are presently being incorporated.

AVAILABLE MATERIALS:

A mimeographed description of the project. (Free)

NEWTON COLLEGE
Newton, Massachusetts

Gerald L. Abegg
Physical Science Group
Newton College
885 Centre Street
Newton, Massachusetts 02159
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PROGRAM DESCRIPTION (Preservice):

Early in 1969 the Physical Science Group* received a grant from the National Science Foundation to develop a four-year program to prepare high school teachers of physics and chemistry. The first class of students was enrolled in the fall of 1969 at Southwest Minnesota State College. The following year Rhode Island College and Western Carolina University joined the program as pilot colleges.

This new program has several characteristic features. First the traditional separation of content and methodology has been eliminated. Beginning in the freshman year, the students are involved in a wide variety of instructional settings. The amount of lecture time is drastically reduced in favor of laboratory and discussion work. Second, the students have an early and continued involvement in public school science classrooms. The work includes observation trips to a variety of schools (junior and senior high) in the first year and some extended visitations in the sophomore year. The amount of time spent in the public schools is increased in the third year and culminates with the student teaching experience in the last year.

Third, the students become actively involved in developing the competencies required of a good science teacher through activities introduced in the science classes. Working in small groups the students develop, analyze, and rewrite test questions on the material they are studying. They become involved in teaching by conducting problem sessions and post-lab discussions in the science and math classes. In the second and third year, each student spends about two weeks as a teaching assistant in the freshman science courses.

Fourth, the course work has a broad base with work in several related areas. Much of the physics and chemistry is treated in an integrated fashion to achieve economy of time and a unity of approach. The two and one-half years of mathematics developed for the program focus on the math skills needed for science teaching and correlate closely with the science topics. The freshman English focuses on communication skills and utilizes the science and math as a source for many written assignments. A special shop course has been developed and is taught in two phases.

Fifth, the science, math, and shop courses are designed to be utilized by students not enrolled in the program but in need of specific work in these areas. Combinations of the freshman and sophomore courses are being utilized for biology, med-tech, and elementary education majors. In addition, efforts are underway to utilize the shop course and selected junior and senior year science courses for chemistry or physics majors.

Students graduating from the program at the three pilot colleges will be certified to teach both chemistry and physics in the secondary schools.

Attached is a summary of the core program for the four years. In addition to this core, students enroll in a variety of electives and general studies courses required for graduation. The materials developed for the specific courses are in various stages of development and testing. The first year materials are nearly completed and are available for adoption in preliminary editions. The other materials, however, will undergo considerable revision before being released.

1) Freshman Year

Science 8-10 Hours/Week (about 60% lab) With the laboratory as a focus, the following groups of topics are studied. Conservation of mass and macroscopic characteristic properties of matter: mixtures, compounds and elements, and the laws of definite and multiple proportions: radioactive elements and the atomic model: conservation of electric charge, electrons, ions, and electrochemistry: heat and electric work: forms of energy and the conservation of energy.

Math I - 4 Hours/Week The major emphasis in the study of mathematics focuses on mathematics as a tool. The course divides into two parts. (1) Numerical techniques including the slide rule and graphing. (2) The study of functions and their recognition from given data. The functions include linear, quadratic, rational, exponential, logarithmic and trigonometric functions.

English - 3 Hours/Week The principal focus is the development of oral and written communication skills using science as a vehicle.

Shop I - 6 Hours/Week (one semester) The development of basic shop skills in the use of hand and power tools on wood, metal, and plastic. A variety of projects are used to focus attention on the skills needed by a science teacher.

2) Sophomore Year

Experimental Physics - 6 Hours/Week (about 50% lab) With heavy reliance on student laboratory data, the following groups of topics are studied. Geometric optics, particle model of light, waves, and wave model of light; Newton's laws of motion, momentum, angular momentum, mechanical energy; Motion of charged particles, Coulomb forces; Electromagnetic induction laws and time dependent currents and voltages; Relativistic dynamics.

Experimental Chemistry - 6 Hours/Week (about 50% lab) Utilizing the first year science as a base the following themes are developed: Chemical composition; Equilibrium and its applications to synthesis and analysis; Rates and their dependence on concentration and temperature; Molecular structure; Functional groups and their infrared spectra.

Math II - 4 Hours/Week The study of functions is continued into the major topics of calculus which are appropriate for chemistry and physics teachers. Included in these topics are: composite functions, slope and area, the derivative, maxima and minima, methods of integration, power series, and Fourier series.

Professional Education About 30-40 hours are scheduled throughout the year for observation visits to a variety of junior and senior high schools. In addition, the student assists in the teaching of the freshman classes.

3) Junior and Senior Years

Chemo-Physics - 7 Hours/Week (three semesters-about 30% lab) The content materials are drawn primarily from two sources; supplementary materials developed and published by Physical Science Group and textbooks on advanced physics, chemistry and physical chemistry. The instructional style requires more independent study and small group work in the classroom and laboratory.

The developing course is built on the following outline of topics:

Single Structures: Atomic spectra and the periodic table; Charge distribution in molecules; Bond strength and length; Binding energies and magnetic properties of nuclei.

Single Reactions: Emission of light, other decays; Scattering, photons, charged particles; Nuclear particles; Reactions (atomic and nuclear).

Many Body Phenomena (applications of the preceding parts): The relation between microscopic and macroscopic properties of matter (e.g., dipole moments and dielectric constants); Reactions of many atoms, entropy and free energy.

Math III - 4 Hours/Week (one semester) This final course in the mathematics sequence concentrates principally on differential equations and the calculus of functions of several variables including vector calculus and coordinate transformation.

Shop II - 6 Hours/Week (one semester) This second phase of the shop course focuses on glassblowing and electronics. The major emphasis is the design and assembly of simple useful teaching devices. In addition, some experience is gained in troubleshooting and repair of equipment.

Theoretical Physics - 3 Hours/Week While a high school teacher need not be an expert in lengthy calculations, he must be conversant with the basic theoretical language. Therefore, the emphasis is an understanding of the physical content of basic mathematical terms.

The course is built on the following lines:

Potential and Gradient: The gradient as a vector, constants of motion, trajectories, scattering and oscillations.

Fields and the Continuity Equation: Conservation of mass and charge, fluid motion, electrical field lines as a conserved fluid.

The second Derivative and the Laplacian: Equilibrium, waves, diffusion and heat conduction.

Professional Education The experience in the public schools is expanded to include extended observation - participation with some limited teaching in the junior year. During the senior year each student completes a 10 - 15 week student teaching experience with a specially trained secondary school science teacher.

At each pilot college the offering in professional education satisfies state requirements.

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*Located at: Newton College, 885 Centre Street, Newton, Massachusetts 02159

AVAILABLE MATERIALS:

Physical Science II - Preliminary Edition of the First Year Science.

Applied Math I - First Year Math Preliminary Edition.

Applied Math II - Second Year Math Preliminary Edition.

Experimental Chemistry - Preliminary Edition of An Intermediate Course.

For materials write to: Dr. Gerald L. Abegg
Physical Science Group
Newton College
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STATE UNIVERSITY OF NEW YORK AT BUFFALO
Buffalo, New York

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PROGRAM DESCRIPTION (In-service):

The in-service secondary science education program is designed to make the teacher aware of the need for continual analysis, synthesis, and evaluation of the social, philosophical and psychological foundations of his science instruction. In order to accomplish this, his academic activities from the beginning of the program are oriented toward the production and evaluation of science instructional modules. The in-service teacher takes the following sequence of courses which activate and develop the content of the program:

Science Curricula
Seminar in Science Instruction
Measurement and Evaluation of Science Instruction
Research Seminar in Science Instruction
Seminar in Science Education

The science curriculum course analyzes the social, philosophical and psychological dimensions of the curriculum. The student constructs conceptual and process paradigms for a science curriculum. He creates a curriculum unit and describes the rational basis for the design that he has used. He then enters the science instruction course where he devises instructional modules based on definable teaching strategies. These modules utilize the foundations framework that he has produced in the curriculum course. The student is required to describe the rationale for the module and to critique an analysis of it made by other students.

After completing the instruction seminar, the students enter the measurement and testing course. He designs evaluation instruments for assessing the instruction module and curriculum unit produced in the previous courses. He is required to argue the rational bases for his instrument. The instrument is field tested and the reliability is determined together with an item analysis.

The science education research seminar takes the products from the previous three courses and teaches the student principles of design and statistics so that he can provide himself with a basis for making decisions about his module and unit.

The final science study activity is the seminar in Science Education. He is given practical situations in this course that extend the skills and knowledge that he has gained to other problems in science education. The sequential nature of the courses provides a vehicle for a long range shaping of the student's attitudes and capabilities.

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
The teacher assumes the role of analyzer, synthesizer and evaluator of his science instruction.	Using major schools of philosophy, sociology, and psychology, the teachers are taught to construct schemata and scales that analyze and evaluate the science content and processes of their instructional materials and strategies.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcomq(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. The teacher constructs schemata and scales to use to analyze and evaluate his instruction. 2. The teacher is able to describe the philosophical, psychological and sociological bases of these schemata and scales. 3. The teacher can use these schemata and scales to analyze and evaluate his instruction and modify it in appropriate directions and magnitudes.	1. The teacher constructs instructional schemata and scales. 2. The teacher argues the rational bases for these schemata and scales. 3. The teacher uses these schemata and scales to evaluate his instruction. 4. The teacher describes a model that can be used to change his behavior (synthesis).

STATE UNIVERSITY COLLEGE AT OSWEGO
Oswego, New York

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PROGRAM DESCRIPTION (Preservice):

The Integrative Professional Semester program came into being as a result of rejecting the traditional or conventional student teaching program in Secondary Education at Oswego. (The conventional model required an on-campus methods course, followed by an eight or nine week student teaching experience in cooperating schools.) The innovative program began in 1967 in the science education area with the cooperation of the Sodus Central School and under the direction of Dr. J. Nathan Swift, Professor of Education at State University College, Oswego. Since then the program has expanded to include English education.

The Integrative Program is a combination of a methods course, student teaching and advanced educational psychology--in an entire semester. The program appears to be true to John Dewey's creed that, "education is a process of living and not a preparation for future living." (Dewey, 1897 originally) The theory components of the program are derived, generally, in the cooperating public school, based upon the particular aims and objectives of the school involved and the needs and interests of students in the classrooms. Thus, instructional strategies and learning theory develop out of experience and relevancy means more than a cliche.

Another important difference in the Integrative Program is the opportunity for the pre-service teacher (college student) to serve in a variety of ways. In the past, one pre-service person worked with one cooperating in-service teacher, gradually assuming more of the in-service teacher's duties, often in a mimicking fashion. The Integrative Program, however, allows for a diversity of experiences: tutoring, working with small groups in different classes (sometimes in different disciplines), and teaching units prepared jointly by the student teachers or in cooperation with the school staff.

Finally, with four or five or more pre-service teachers working in a school as a center, the staff involved will be able to accomplish "things they normally cannot do." For example, in addition to the diversity of instructional strategies, the staff might also conduct common planning or work sessions or to conduct in-service workshops during the school day.

The Integrative Professional Semester Program is a major thrust in changing teacher education to an emphasis on process, facilitation of learning, understanding the teacher as a human being, and the development of closer cooperation between the public school and the college staffs in humanizing the educational process.

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
There is no single model of teaching behavior that is clearly most effective.	Place the candidate, in a field-centered environment whereby he can learn to function in a way uniquely suited to his own talents.
Content is taken from the areas of reading, educational psychology, curriculum, and instruction. Emphasis is on a humanistic and individualistic approach to students both in and out of the classroom.	To insure both relevancy and effectiveness, these components form our integrative professional semester. An interdepartmental team of educators work closely with field professionals. Input from these sources continues throughout the semester.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
The candidate develops his own ideosynertic teaching style.	The effectiveness of this teaching style is evaluated through observation by two or more cooperating public school teachers and a team of professional college educators.
The candidate, starting the professional semester with some degree of native competence, is able to incorporate content from the many sources, testing these ideas in the classroom. Difficulties and successes are brought back to the team members, which include peers, and retrial is facilitated. At the end of the semester, the candidate exhibits a healthy degree of confidence in his teaching ability.	A research proposal has just been developed to compare the process-orientated professional semester with conventional programs. Subjective evidence and preliminary research data are very favorable. Reaction from employers is excellent. Candidates are so enthusiastic that they enlist others to this approach.

It is our assumption that all persons are process-oriented to some degree, and that teachers, in particular, can become more process-oriented through planned experiences in the public schools. These persons are on-going, growing, developing human beings (Berman, 1968).

Specific process skills developing in the program are: perceiving, communicating, loving, decision-making, knowing, organizing, creating, and valuing (Berman, 1968).

The following specific objectives are for the pre-service teacher:

(1) To develop an attitude of openness toward and awareness of public school students' needs and interests
(2) To develop the ability to utilize a variety of learning strategies
(3) To develop the ability or skill to identify different teaching styles and their respective effect upon students
(4) To develop an integrative rather than a directive attitude
(5) To facilitate the pre-service teacher's opportunity to clarify his perception of himself as a person and of his role as a teacher

Other objectives of the program are:

(1) To facilitate team planning wherever applicable
(2) To develop the curriculum planning process in participating schools
(3) To develop skills in peer evaluation and the clinical analysis of teaching

Pre-service students who select the Integrative Program spend approximately three weeks on the college campus for general orientation, developing skills in inter-personal relations, and to examine their perceptions of themselves as people and as potential teachers. The students also receive an introduction to some learning strategies, exposure to value clarification methods, examination of interaction assessment instruments, and review of essential elements such as the writing of behavioral objectives. A two or three day visit to assigned public schools is planned during the on-campus experience for interviewing and public school orientation purposes.

After the intensive on-campus experience, the pre-service teacher "joins" the public school staff where he assumes a variety of duties and tasks, depending on the needs of the particular school. Students stay in the schools for a twelve week period. The public school is free to assign duties in general consultation with the college personnel.

Bi-weekly seminars are held in the public schools where the cooperating teachers are included. The purpose of the seminars is to exchange concerns and problems in teaching and related curriculum. The seminars are conducted by the college supervisors.

Pre-service teachers complete a pre and post-test of the Rokeach Dogmatism Scale. Last fall the results appeared to conform to the general research pattern--open students generally remained open or closed somewhat while most closed students remained closed. Exceptions were those students who were in well organized team teaching situations. They were more open.

The Teaching Situation Reaction Test (Duncan and Hough, 1966) was also administered on a pre- and post basis last fall. The results are not available at this time.

Next fall ('72) an experimental design will be employed. Subjects will be randomly selected for the control and experimental conditions from students involved in English education, mathematics education and social studies education. No control group will exist in the sciences since all science education majors are in the Integrative Program.

The tests to be utilized are the Teaching Situation Reaction Test (Duncan and Hough, 1966 - 5th Rev.) and the Teacher Perception Q Sort (Gooding and Wilbur, 1970). A two-by-two repeated measures design (Kerlinger, 1964) utilizing computer procedures (Wilbur, Gooding and Vincent, 1970) will be applied to the data gathered.

The improvement of reading in the content areas is a growing concern of most high school teachers. Therefore, there is a possibility that a reading education course may be included in the Integrative Program. Then, a reading specialist, a psychologist and secondary education specialists in four or five disciplines will be working together with public school personnel, developing curriculum, providing appropriate learning experiences for pre-service teachers, and providing professional growth opportunities for in-service teachers.

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3. Dewey, John, "My Pedagogic Creed," Dewey on Education. New York: Columbia University, 1959.
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5. Gooding, C. T., and Wilbur, P. H. Teacher Perception Q Sort. Oswego, N. Y.: State University of New York, 1970.
6. Kerlinger, F. N. Foundations of Behavioral Research: Educational and Psychological Inquiry. New York: Holt, Rinehart and Winston, 1964.
7. Rogers, Carl R., Freedom to Learn, Columbus: Charles E. Merrill, 1969.
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AVAILABLE MATERIALS:

"Undergraduate Pre-Service Program" by J. Nathan Swift. ESCP Newsletter October, 1969, p. 1-3. (No charge unless demand is large)

"Research Proposal - The Integrative Professional Semester: A Field Centered Approach" by Wilbur, et. al. College publication. (No charge unless demand is large)

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THE OHIO STATE UNIVERSITY
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PROGRAM DESCRIPTION (Summer institute):

The introduction into high schools, beginning some 15 years ago, of "earth science" (commonly to replace "general science") caught the community of teachers almost entirely unprepared. Although the past ten years or so have witnessed the training of some teachers in the various subjects concerned, there are still far too many experienced teachers on the job who need instruction.

Geology is the central, basic science of the earth, and the ideal way to study geology is to study the earth itself. The work is done in the field, centered at the geologic field station of the Ohio State University and located on the campus of Snow College, Ephriam, Utah.

Not only do we give the teachers (who must have at least three years of teaching experience) an exceptional opportunity to learn the fundamentals of geology, but as the work proceeds they learn not only the subject itself, but also how to teach it.

Ultimately, teaching is an art. To master any art certain techniques must be learned, but the practice of the art itself we learn by observing master artists and being guided by them.

In our Institute we have always made it clear to the teachers that we do not pretend to teach techniques -- we accept our participants as well trained and experienced in such matters -- but Dr. Lautenschlager, who does most of the work with the teachers in the field, is a master of the art, and especially those elements of it that are peculiar to the teaching of geology; the teachers cannot fail to learn from him, and they realize it.

The course on the nature of science is based on the principle (first noted by Aristotle, I believe, but introduced at Ohio State University by Dr. William Edwards Henderson in 1926) that one good way to reach understanding of a thing is to see something of how it came to be what it is. The work is therefore built on an historic base, but the course is by no means a history of science. For one thing, the history covered is highly selected -- basic, representative, and comprehensive as regards the various elements of scientific method. Two major lines of development are discussed: 1) physical and chemical science, and 2) biologic and geologic science. In the first of these treatment is central but general through the 19th century, and thereafter concentrated on the nature of matter and the concept of relativity. In the second area

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Basic understanding of 1) Geology 2) The nature of science	1) Teachers learn geology through guided study of the earth itself (not from textbooks) in a highly favorable area (central Utah). 2) The nature of science is brought out by critical review of its development in three major sequences and its impact on society.

OUTCOME(S)	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1) Ability to stimulate interest in and impart knowledge of the earth and its history. 2) Fuller understanding of what they are doing as they teach any science.	Nothing systematically planned but 11 years of voluntary and enthusiastic response from "alumni".

two lines are followed: first, medical science and the conquest of disease, and second, the general concept of evolution, which of course includes geology as well as biology, the evolution of the earth as well as that of its inhabitants.

In all of it, the relations between science and other elements of our culture are constantly in view -- science and philosophy, science and values (including the present-day "Humanistic" rebellion against science), science and sociology, science and technology and their relation to invention (which may be entirely independent -- e.g. Edison), science and religion. Science itself is seen to be actually a humanistic concern.

The most important element in the whole picture is the scientist's way of thinking, and the most important general objective is to see that everyone concerned understands clearly, through abundant and various example of the way of thinking as it has developed, what science really is, and, of equal importance, what it is not. A teacher who has once grasped this at all maturely is in excellent position, granted the requisite mastery of the art of teaching, to inspire pupils with the necessary understanding.

AVAILABLE MATERIALS:

None listed.

THE OHIO STATE UNIVERSITY
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PROGRAM DESCRIPTION (Preservice):

The preservice program in science education at The Ohio State University represents an attempt to combine educational theory with classroom practice and to enable preservice teachers to acquire experience in working with pupils in instructional and community settings at different grade levels (elementary, junior high, and senior high). The present program consists of a five quarter sequence in science education.

Junior Program

A general description of the first quarter of the junior year program (J1) is outlined below.

1. Focus: Individual junior high school students

2. Objectives: The J1 student will

   a. Be able to identify the interests, needs, and background of an individual student.
   b. Identify some learning styles of junior high school students.
   c. Be able to identify and locate resources which can be used in attempting to help students learn.
   d. Become able to communicate effectively with a student in a one-to-one relationship.
   e. Develop and use a variety of tutorial teaching strategies.
   f. Gain poise and confidence in his ability to function as a tutor.
   g. Develop means of evaluating his own progress as a tutor as well as his student's progress in learning mathematics or science.
   h. Become an intelligent observer of classroom interaction and the resultant influence on individual student interest and achievement.
   i. Gain insight into the many and varying roles of a teacher.
   j. Become acquainted with the philosophy and objectives of a particular junior high school and the school's instructional procedures, administration, counseling, and mathematics or science department personnel.
   k. Become aware of personal strengths and weaknesses as a potential teacher, particularly in a junior high school setting.

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Selected Examples:	Selected Examples:
1. Effective questioning skills are needed for a teacher to effectively interact with students and for a teacher to provide effective guidance in group discussions.	1. Prospective teachers are provided with instruction in questioning skills. A handbook describing various questioning as a process and including suggestions for instruction is used with the prospective teacher. Prospective teachers utilize ideas in classroom settings and tape (video or audio) their interaction with students. Tapes are reviewed by faculty and then discussed with the prospective teacher. Subsequent instruction is modified to improve skills.
2. Knowledge and skill of modes of concept formation are necessary for a teacher to effectively guide and organize instruction.	2. Prospective teachers are provided with instruction regarding concept formation related to science education. They utilize this information to diagnose learning difficulties of students and to provide appropriate instruction for individuals and groups of students. Assessment of their planning and instruction is provided to help them to modify their planning and instruction for future student groups. Various aspects of concept formation are presented throughout the total program.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
Selected Examples:	Selected Examples:
1. (a) The prospective teacher learns different types of questions.	1. (a) The prospective teacher can listen to an audio-tape or read a typescript of a lesson and identify the types of questions asked.
(b) The prospective teacher learns how to control his instructional style.	(b) The prospective teacher can reduce the percentage of teacher talk and increase the amount of student talk during a lesson.
(c) The prospective teacher learns the purpose of pause time after questions and how to use the technique.	(c) The prospective teacher can increase the amount of pause time after either teacher questions or student questions.
2. (a) The prospective teacher learns how concepts are categorized.	2. (a) The prospective teacher can define selected categories of concepts.
(b) The prospective teacher learns instructional strategies for teaching different concepts.	(b) The prospective teacher can design an instructional sequence or series of activities to teach a specific concept.
(c) The prospective teacher learns how to diagnose learning difficulties that might affect the attainment of concepts.	(c_1) The prospective teacher can identify instruments to use to determine learning difficulties. (c_2) The prospective teacher can interpret data obtained from instruments to determine possible student learning difficulties.

3. Program:

Each college junior works as a tutor in a junior high school with a pupil. The J1 student tutors his pupil twice a week, one period each time. Video tapes are made of some tutoring sessions and are analyzed in follow-up seminar sessions. The J1 student spends additional time in the school observing science and other classes, and in becoming acquainted generally with the school's program and staff; a college staff person is present to serve as a resource person in these efforts.

Two seminars are held each week. Seminar discussions center around problems encountered by the J1 students in their tutoring situations or in other situations they have observed in the school. These problems might include methods of identifying learning problems, alternative means of motivation, instructional strategies, teaching styles, methods for stimulating interest in science, and the development of methods to evaluate the success of tutoring sessions.

A general description of the second quarter of the junior year program (J2) is outlined below.

1. Foci: Individual (elementary school) pupils as members of small groups; child growth and development; and learning theories.
2. Objectives: The J2 student will
    a. Become able to identify individual pupil and teacher differences which influence the learning patterns of elementary school pupils.
    b. Develop and use instructional strategies which honor individual differences in small groups.
    c. Become familiar with group dynamics research and start to use this information to improve teaching and learning in small and large group settings.
    d. Become aware of the elements involved in the concept of "motivation" and the importance of motivation as a factor in pupil success in school.
    e. Acquire knowledge of child growth and development and apply this knowledge in learning activities to be used with pupils.
    f. Acquire knowledge of what is involved in concept formation and problem solving and apply this in learning activities.
    g. Acquire understanding of what is involved in creativity and divergent thinking and use this in learning activities.
    h. Identify curriculum problems and programs and materials designed to provide solutions to these problems.
    i. Become acquainted with the objectives and philosophy of the school's program and its relation to the corresponding secondary school program.
    j. Become familiar with the philosophy and functioning of a particular elementary school, its staff, and the population it serves.
    k. Learn to function as a member of a teaching team as he works with other adults and a class of elementary school pupils.
    l. Become increasingly aware of his personal strengths and weaknesses as a potential teacher, particularly with elementary and junior high school pupils.

3. Program:

As many as four J2 students may be assigned to a single cooperating teacher in an elementary school, but each student is primarily responsible for only one small group of pupils. J2 students spend four to six hours per week in the school with about half of that time devoted to instruction of their small groups and working with their cooperating teachers. The remaining time is used in observing class activities in the building, and in conferring with their cooperating teachers and with other school personnel.

Two seminars are held each week related to educational psychology. Seminar topics again center around problems encountered by J2 students and might include establishing favorable learning climates, teaching techniques useful for small groups, principles of group dynamics, methods of analyzing student interaction, ways of utilizing individual differences in teaching science and other matters related to understanding and using a sound psychology of learning.

A general description of the third quarter of the junior year program (J3) is outlined below.

1. Focus: Individual junior/senior high school students in laboratory and and classroom settings.

2. Objectives: The J3 student will

   a. Apply knowledge of teaching-learning theory and adolescent psychology to solve problems encountered in the classroom.
   b. Demonstrate effective inquiry strategies for laboratory activities in high school science classes.
   c. Use behavioral objectives, involving the three domains, in preparing lesson plans for classroom or laboratory instruction.
   d. Use effectively audio-visual materials appropriate for teaching specific topics or concepts.
   e. Demonstrate a knowledge of appropriate evaluation techniques for assessing outcomes of instruction; including student self-evaluation.
   f. Identify different patterns of pupil and pupil-teacher interaction as they occur in small and large groups.
   g. Identify characteristics of a favorable learning environment.
   h. Exhibit poise and confidence when placed in charge of various teaching situations.
   i. Become familiar with the philosophy and objectives of a particular senior high school.
   j. Use self-evaluation techniques regarding his personal strengths and weaknesses as a potential teacher.

3. Program:

J3 students are assigned in pairs to a junior or senior high school science class with the expectation that they will have regular opportunities to conduct laboratory activities. While the student may work with his cooperating teacher as a laboratory assistant, he is also responsible for teaching laboratory activities to the total class.

Seminars are held twice a week. Seminar problems focus on total classroom activities, methods and strategies for inquiry teaching in a laboratory setting, evaluation techniques, problems of adolescents, dynamics of group interaction, and the philosophy and operation of a specific senior high school.

Senior Program

A general description of the first quarter of the senior year program (S1) is outlined below.

1. Foci: The influence of contrasting communities and differing grade levels on teaching-learning in secondary schools; A problem solving stance toward pedagogical problems in science education.

2. Objectives: The S1 student will

   a. Develop an understanding of the underlying cultural elements characterizing urban, suburban, and rural areas and their impact on the schools.
   b. Develop sensitivity to the differences in cultural backgrounds of students and the effect of these differences on learning.
   c. Re-examine similarities and differences between junior and senior high school students and the educational programs offered to each.
   d. Acquire understanding of the origin and nature of the charge made by some critics that the public school system is racist and irrelevant and does not meet the needs of groups such as inner-city blacks.
   e. Acquire a sense of the political workings and functioning of a department, school, and school system.
   f. Become more aware of the nature of good teaching and the characteristics of "good teachers" as perceived by high school students.
   g. Develop insights and skills involved in long and short term planning for teaching.
   h. Acquire insight regarding how students' cultural influences and learning capabilities should guide the selection of instructional objectives, activities, materials, and methods.
   i. Become able to interpret test scores from teacher made and standarized tests, apply statistical techniques to test construction and use this information to improve the teaching-learning situation.
   j. Become able to analyze a video-tape or audio tape of his teaching to gain insight into verbal and non-verbal behavior. Demonstrate the ability to evaluate his teaching performance.
   k. Explore the use of team teaching.
   l. Gain a spirit of professionalism which includes striving for considered changes and improvements.
   m. Continue to achieve, at a higher level, many of the objectives listed for previous quarters.

3. Program:

S1 students are assigned in pairs to work with cooperating teachers as teaching assistants for four weeks in an inner-city school and an equal time in an outer-city school. The S1 students assist teachers and engage in other activities in the schools four periods a day, five days per week.

The college seniors provide considerable help as junior members of "instructional teams." They prepare and conduct demonstrations, assist in laboratory work, prepare guidesheets or other instructional materials, assist in evaluating pupil progress and work with individuals and small groups in need of special help. In addition the senior gets an opportunity to teach an entire class several times during his four weeks of heavy involvement in the schools.

Seminars which focus on understanding school based experiences in a framework of principles, practices, and philosophies of secondary education are held twice a week. In addition to the seminars there is classwork in philosophy and/or sociology of education. S1 students also continue to study special methods of teaching science and develop instructional materials which they can use in the schools or in their future teaching.

Students are expected to become aware of many of the "realities of public schools" by observing widely throughout the school, by talking with many school personnel, by informal conversations with pupils, by attending after school or evening functions such as faculty or PTA meetings, and by studying the socioeconomic factors in operation in the school's attendance area. Students also are introduced to the educational problems and practices found in other cities.

Specialists from areas such as urban sociology, mental health, juvenile delinquency as well as educational personnel from the Columbus public schools are involved as resource personnel for on-campus discussions about educational problems.

Each S1 student keeps a "log" which is a personalized record of his experiences during the quarter with particular emphasis on analyzing, interpreting, and evaluating the experiences.

A general description of the second quarter of the senior year program (S2) is outlined below.

1. Foci: Successful student teaching experience which integrates previous professional learnings.

2. Objectives: The S2 student will

   a. Integrate and utilize the skills and understandings developed through involvement previously in the J1, J2, J3, and S1 programs.
   b. Test and evaluate instructional ideas through classroom application.
   c. Become familiar with and active on a full-time basis in the school-community setting.
   d. Identify community resources in his school's attendance area and in larger community which are available and useful in developing his instructional program.
   e. Use evaluation feedback in dealing with parental concerns relative to their child's growth and development.

3. Program:

The S2 student is usually assigned to full-time student teaching with a cooperating teacher he has worked with the previous quarter. In this situation he is usually able to take immediate responsibility for two classes and very quickly assume total responsibility for three classes. The remainder of his time in the school is used to broaden understanding and competency by (1) working with other teachers in his discipline in the school, (2) observing other teachers and students in a wide variety of situations, (3) helping with the extra-curricular activity program, (4) supervising study halls and lunchrooms, (5) helping with testing, grading, and record keeping responsibilities, and, in general, doing almost everything that will be expected of him as a regular teacher. For a period of time, the senior assumes a full teaching and supervisory load as carried by regular teachers.

While providing a model of good teaching, it is hoped that the cooperating teacher, working with the student and with the college supervisor, will help the student develop his personalized style of teaching, which may be similar to or quite different from that of his cooperating teacher.

It is anticipated that the cooperating teacher and senior will plan a sizeable number of teaching situations in which they work together as an instructional team, thereby enriching instruction and,hopefully, learning from each other.

The cooperating teacher is expected to regard himself as a very important part of a teacher education team working with the college supervisor and others to prepare better science teachers.

AVAILABLE MATERIALS:

List of references related to the program-description and evaluation. (FREE)

Packet of materials including forms used in the various aspects of the program, advising, selective admission. ($.50)

List of instructional materials used in the program. Costs of those produced at Ohio State included. (FREE)

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Corvallis, Oregon

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PROGRAM DESCRIPTION (Preservice):

Beginning in September, 1972, the Department of Science Education at Oregon State University launched a "block" program in the professional education phase of the undergraduate science and mathematics teacher education program. Only student teaching and a course in Methods of Reading fall outside the blocks.

The Sophomore Block combines three courses in which eight hours of credit may be earned. The courses are Contemporary Education, School in American Life, and Educational Psychology. To earn the credit the student spends 2 1/2 to 3 hours daily, and for the entire quarter, in an elementary school classroom or in some elementary education specialty area (e.g., the school's reading clinic). Two times each week the students attend a late afternoon seminar during which time the principles normally discussed in the three original courses are presented. Three instructors direct the block program and manage the seminars. Two of the instructors are members of the Department of Science Education, and one is an educational psychology specialist. Enrollments are expected to average 25 students per quarter for each of the three quarters of the academic year. The School of Education of our University has contractual arrangements with local public school districts to accommodate the university block students.

The Junior Block combines three courses in which nine hours of credit may be earned: Special Methods in Science Teaching, Adolescent Psychology, and Audio-Visual Aids. The enrollees are in junior or senior high school science or mathematics classrooms 2 1/2 to 3 hours per day every day of the week for the entire quarter. The assignment is to a junior high school if the student teaching is to be in a senior high school, and in a senior high school if student teaching is to be in a junior high school. Two times each week the students attend late afternoon seminars during which time the principles normally treated in the three original courses are presented. Three instructors direct the block program and manage the seminars. Two of the instructors are members of the Science Education Department,one represents the Division of Foundations and Educational Specialties. For this program, as with the Sophomore Block, the School of Education has contractual arrangements with the local public schools. Enrollments are expected to continue at between 20 to 25 students per quarter for each of the three academic year quarters.

Students in the Junior Block also enroll in a 1-hour practicum in which they prepare micro-lessons to demonstrate specific teaching skills. These lessons are presented to small groups of classmates and are videotaped. During replay the presentations are criticized by instructors and peers.

Experience thus far has suggested the following generalizations: (1) Elementary teachers enthusiastically welcome the science and mathematics visitor-participants even though the university students are expected to do very little or no work in these fields. Junior and senior high school science and mathematics teachers thus far have not been as enthusiastic about having visitor-participants in their classes. They have been quite cooperative, however. (2) The university students generally approve the participation approach to meeting their professional education requirements. "Relevance" and "meaning" are terms often used. (3) The amount of "content" presented in the seminars in comparison with that which normally would be presented in individual courses is very low. One instructor suggests that only about 20% is managed.

The block approaches described above are the result of two recent developments along with a history of teacher education experiences. The State Department of Education in Oregon is expecting that more of the teacher education programs will be based on field experiences. In addition, the State Department recently defined the secondary certificate in terms of teaching eligibility from grades 5 to 12. (Elementary certification is from grades K to 9.) The second development is that the Elementary Division of our School of Education has been enjoying rather remarkable success with its block approach, and the secondary educators are capitalizing on their experiences. A hidden factor is that over recent years a very wholesome reciprocal relationship has been developing between our School of Education and neighboring public school districts.

Following is a tentative OUTLINE OF EXPERIENCES AND AREAS OF STUDY IN THE PRE-PROFESSIONAL PREPARATION OF SCIENCE AND MATHEMATICS TEACHER-CANDIDATES. The outline is used for some of the sophomore and junior block activities, but does not cover some areas such as adolescent psychology.

I. Objectives of science (mathematics) education
II. Planning learning activities to assure attainment of desired learning outcomes
III. Modern science (mathematics) curricula
IV. Teaching Strategies
V. Educational Media
VI. Systematic observation and analysis of classroom behavior
VII. Classroom control
VIII. Evaluation of the effectiveness of the curriculum and instruction

The Field Experience phase of the pre-professional (Sophomore and Junior) blocks aims at the following experiences:

1. Self-analysis of teacher-candidate's interest and potential as a classroom teacher
2. Learning (knowledge, skills, attitudes) through first-hand experiences in the public schools
3. Initial development of skills in analyzing and prescribing learning situations for pupils on a one-to-one or small group basis

4. Developing skills in working as a member of a teaching team

5. Beginning to apply knowledge and skills identified in items I through VIII above.

Student teaching requires the application of knowledge, skills, and attitudes developed through academic work and pre-professional (sophomore and junior) blocks in representative classroom situations. There is also a required demonstration of at least adequate levels of competency in classroom management and in the diagnosis and prescription of learning situations for individuals and groups of students.

AVAILABLE MATERIALS:

None listed.

PURDUE UNIVERSITY
Lafayette, Indiana

Van E. Neie
Department of Physics
Purdue University
Lafayette, Indiana 47907
(Telephone: 317-493-1589)

PROGRAM DESCRIPTION (Preservice):

All teacher-education programs at Purdue University are the responsibility of the Teacher Education Council, a University-wide council comparable to a committee on graduate studies. Professional education courses are the responsibility of the Department of Education. However, all teaching candidates major in a subject matter department and graduate from the School under which the department is administered. A result of this arrangement is that the professional education experience is not encountered until the student's final semester. There are not sufficient numbers of teaching candidates at present to warrant separate courses for these students in their academic discipline. Thus, for the present time, it appears that the program will remain as is with regard to sequence of courses. What follows is a brief account of what the physics and chemistry education sections at Purdue are attempting in the way of innovation within the present structure.

The "professional semester" consists of a general methods course in science and a special methods course in the student's discipline. In addition there is a course on the American School System and six semester hours of student teaching. The coursework constitutes the first eight weeks, followed by six weeks of directed student teaching.

The general methods course is designed around a mastery model and is structured according to the basic principles set forth in A Tentative Theory of Instruction by J. Dudley Herron and Grayson Wheatley of Purdue University. Each basic principle of the Tentative Theory is the basis for a learning package, or Unit, each of which consists of a list of the objectives to be mastered, a pre-test, a suggested set of learning activities, and a post-test. These units are supplemented by large and small group discussions, peer teaching, and audio-visual aids. Some of the Units are adaptations of learning modules developed by Dr. Herron to be used in a completely individualized, self-paced general methods course.

Each of the Units are evaluated on a pass-fail basis and the student may retake any or all of the Units until he has achieved mastery on that Unit. Mastery of a Unit is defined as a pass grade on the Unit post-test. There is a final examination at the end of the eight week period. This exam is a test of the student's ability to apply the principles contained in A Tentative Theory of Instruction to a classroom situation, either real or simulated. To receive a grade of A in the course a student must successfully complete all eight units and pass the final examination. One less unit completed results in a B, etc.

CONTENT	STRATEGY
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Teacher Candidates (T.C.'s) should have early encounters with actual teaching situations to provide a reference frame from which a theory of instruction may be viewed.	T.C.'s begin by teaching peers or students on a one-to-one basis, focusing on strategies and outcomes.
Effective and efficient learning occurs only when the student is motivated.	T.C.'s develop motivating strategies and try them out on peers or small groups of students.
The effective teacher elicits feedback to assess the effectiveness of his/her instruction and to plan future strategies.	T.C.'s engage in peer- and micro-teaching activities to determine the effectiveness of the instruction and to utilize feedback in designing further strategies.
Evaluation is essential for measuring progress and diagnosing deficiencies in both students and learning strategies.	T.C.'s utilize real-time feedback and written evaluation instruments to assess degree of S's progress in learning.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
To recognize the effectiveness of various teaching and feedback elicitation strategies.	Teacher Candidates (T.C.'s) will give supportive evidence that their strategies resulted in a given outcome.
Learns criteria for effective motivation and is able to generate a variety of motivating strategies.	Students or peers rate the T.C. as to the effectiveness of his/her motivating strategy.
To modify existing or plan new instructional strategies based on feedback from students.	Supervisor testifies to the T.C.'s ability to plan or modify instruction based on feedback from students.
Design and/or specify the proper evaluation techniques for a given goal(s) of instruction.	Evaluation techniques meet the criteria specified by the instructor(s), e.g. efficiency validity, etc.

The special methods courses allow the student to apply these principles to instructional situations within his discipline. For example, he learns how to motivate (confront) students by designing lessons that foster inquiry or by designing a motivating experiment or demonstration. He is able to test certain teaching strategies, i.e. evaluate their effectiveness, through participation in such activities as micro-teaching, peer-teaching, and working with high school teachers as classroom aides.

The end result is an acquired set of competencies believed to be essential for effective teaching. Once the instructors have ascertained that these competencies have been acquired (or the enroute objectives have been met), the student is ready to apply what he has learned in a real classroom setting on a day-to-day basis, i.e. through the experience of directed student teaching.

AVAILABLE MATERIALS:

None listed.

THE UNIVERSITY OF TOLEDO
Toledo, Ohio

John F. Schaff
College of Education
The University of Toledo
Toledo, Ohio 43606
(Telephone: 419-531-5711, Ext. 2465)

PROGRAM DESCRIPTION (Preservice):

Secondary science teacher education at the University of Toledo is embodied within the Competency Based Teacher Education program of the College of Education being implemented for the first time this academic year. Previously, the education program consisted of three foundations courses, major and minor subject field methods courses, and student teaching. As characteristic of most traditional teacher education programs, the courses were distinct and taught by a single instructor with each course reflecting the specific views and interests of the instructor. This resulted in a non-coordinated and fragmented program.

With implementation of the Competency Based Teacher Education program, several changes have been effected in the instructional process. Separate courses have been replaced with a sequence of modular-based learning experiences designed to progressively develop each student's competencies over a three quarter period culminating with a full-time student teaching encounter. Instructional teams composed of instructors specializing in learning foundations, educational psychology, educational measurement and instructional methods for different subject fields work together in guiding students through the professional sequence. Thus students are provided with opportunities to continuously interrelate different components of the teaching-learning process rather than examine separate aspects in different courses.

The initial objectives to be achieved by students are general in nature. However, students are afforded opportunities to examine and apply knowledge gained and skills developed to situations representing their major subject fields. For example, when studying inquiry learning, instructional objectives, and evaluation of learning, the students learn the basic concepts and skills in conjunction with their application to a specific subject field. The science methods instructor teams up with foundations instructors to guide secondary science teaching majors through objectives focused on direct applications of basic principles to science teaching. The overall professional sequence progresses from general objectives bearing on the teaching - learning process and basic teaching skills to specific objectives related to the student's major teaching field. Consequently, subject field methods instructors have a predominant influence on the student's terminal objectives as he nears and progresses through student teaching.

A prominent feature of the Toledo Competency Based Teacher Education program is a concentration on field (school) based experiences to mediate the various objectives. Students spend considerable time studying the teaching -

CONTENT +	STRATEGY —
List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Analysis of Student Behaviors as they relate to learning science. Examination of student interests, needs, and attitudes, and how they can be met through science instruction.	Preservice science teachers observe student behaviors in science classrooms and informally interview students on an individual basis or in small groups. Results obtained are examined in discussions concerned with adolescent behaviors.
Development of inquiry oriented teaching strategies using five basic teaching styles: lecture, teacher demonstrations, teacher guided student discussions, student discovery, and individualized instruction.	Preservice science teachers study the nature of inquiry teaching and learning, and its application to different situations in science instruction. Lesson plans are prepared for each teaching style and demonstrated in peer-group mini-teaching encounters.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. Preservice teachers learn to identify student interests, needs and attitudes as they relate to science instruction. 2. Preservice teachers describe student interests, needs and attitudes that must be coped with in science classes.	1. Preservice teachers correctly identify student interest, needs and attitudes reflected in videotapes of science classes. 2. Preservice teachers present written reports to science methods instructor describing student interests, needs and attitudes observed in science classes.
1. Preservice teachers learn to identify and describe the advantages and disadvantages of different teaching styles in secondary school science teaching. 2. Preservice teachers can demonstrate effective implementation of different teaching styles in science instruction.	1. Preservice teachers present written reports of different teaching styles observed in science classes in local schools. 2. Preservice teachers correctly identify different teaching styles shown in videotapes of science class(s) instruction. 3. Preservice teachers demonstrate effective implementation of different teaching styles in peer-group mini-teaching encounters.

learning process in both urban and suburban school sites. While mastering instructional objectives, science majors concurrently participate in a local school to analyze the instructional environment, organize an instructional program with a science teacher, and prepare for effective instructional procedures to implement the instructional program. By the time they enter student teaching, science majors have had numerous occasions to become familiar with their cooperating school; the nature of the system, its instructional program and the facilities available. In addition, students have an excellent opportunity to establish a working relationship with their cooperating teacher. Most significant in the school based experience is the provision to relate theory learned in the university classroom to current practices in secondary schools. Many insights with respect to the application and modification of ideas to secondary school science classrooms are gained.

The program is designed to accommodate individual student differences in several ways. Many modules are prepared for self-paced instruction, therefore, students may progress through them at their own speed. Preassessment instruments are available which allow students an opportunity to determine their entering competencies before engaging in the instructional process. Students demonstrating mastery of terminal competencies are advanced in the program on an individual rather than a group basis. Consulting with their major subject field instructors, students develop competencies within their major subject specialty; e.g., chemistry, biology, physics, or appropriate combinations of each, depending on interest and academic background. A wide variety of local school environments, both public and private, are available for student field experiences, providing students with an opportunity to select the type of school for student teaching possessing characteristics similar to one in which they anticipate employment following completion of the program.

AVAILABLE MATERIALS:

Analysis of Instructional Environment (50¢)

Organizing An Instructional Program (50¢)

Preparing For Effective Instruction (50¢)

For materials write to: Dr. John F. Schaff
College of Education
University of Toledo
Toledo, Ohio 43606

UNIVERSITY OF TORONTO
Toronto, Ontario

R. G. Casson
The Faculty of Education
University of Toronto
371 Bloor Street, West
Toronto, Ontario
(Telephone: 416-928-6045)

PROGRAM DESCRIPTION (Preservice):

The major program of the Faculty of Education, University of Toronto (FEUT) is a one-year program leading to a Bachelor of Education Degree in addition to an Ontario Department of Education Teaching Certificate.

The basic requirement for admission to the program is an approved degree from an accredited university.

The program consists of four parts as follows:

Part I Teaching Subjects (two courses) e.g., Science, Mathematics

Part II Educational Theory (four courses)

All candidates are required to take the course, Structural and Legal Bases of the Ontario School System, plus three courses from at least two of the following departments:

Administration and Program Development
Educational Psychology
History, Philosophy, Sociology of Education

Part III Professional Practice (ten weeks of practice teaching with selected associate teachers)

Part IV Additional Related Courses (one course)

The Additional Related Courses offer the candidate an opportunity to concentrate further on one of his teaching subjects or to pursue an interest in the area of general education.

The Science Education Department of FEUT offers the following courses for credit leading to the Bachelor of Education Degree and to Ontario Department of Education Certificates.

Science 470. This course consists of 4 hours per week and is open to any candidate with an approved degree from an accredited university. The candidate must have chosen five courses in Science during his university program.

Topics dealt with include the role of science in elementary and secondary education; the aims and objectives of science education; a study of various teaching strategies; a study of representative portions of contemporary science courses; lesson, unit and curriculum planning; testing and evaluation; the use of audio-visual aids; source materials; the purchase, maintenance and use of equipment; safety in science.

Successful completion of Science 470 forms part of the requirements for the Ontario Interim High School Assistant's Certificate, Type B.

Biology 0300, Chemistry 0500, Physics 4100. These consist of 6 hours per week and are open to candidates having an approved four-year degree from an accredited university with the required number of courses in the area of specialization.

In addition to covering the content of Science 470, these courses explore the methodology and content of the science courses taught in the senior division of the Ontario Science Curricula.

Successful completion of Biology 0300, or Chemistry 0500, or Physics 4100 forms part of the requirements for the Ontario Interim High School Assistant's Certificate, Type A.

Environmental Studies 109, is an additional related course requiring two hours per week. Material is selected from the areas of freshwater ecology, terrestrial ecology, environmental pollution and urban studies to supplement existing science programs or to build an interdisciplinary course in environmental studies. Field experience is also provided for candidates electing this course.

Science Programs in Elementary Education 140. This course is another additional related course requiring two hours per week. The course explores science programs used in elementary education with specific references to procedures specific to age levels. Various methods of correlating science in the senior elementary and junior secondary grades are explored.

AVAILABLE MATERIALS:

None listed.

Nyles G. Stauss
350 South Pope Street, Apt. 7
Athens, Georgia 30601
(Telephone: 404-549-1499)

PROGRAM DESCRIPTION (Preservice):

Components of a Secondary Science Methods course, as described herein, were developed by the author at the University of Georgia as part of the professional education sequence for prospective secondary science teachers. The methods course was preceded by several courses: Introduction to Education, Educational Psychology, and School Practicum. After the methods course, students spent one quarter in Student Teaching. The students generally enrolled in the methods course no more than two quarters prior to student teaching, and after completing most of their academic coursework in their teaching area.

Several major areas of concern may be identified as methods course objectives. One such objective is for the student to develop an understanding of the nature of science and its relation to science teaching. Knowing some of the products of past scientific investigations is considered important, but far more importance is attached to the attainment of a fundamental understanding of science as a dynamic on-going enterprise. The latter manifests itself in the intellectual skills that form the methods and modes of inquiry, as well as in the conceptual schemes with their logically, hierarchically organized systems of concepts forming the framework for the structure of knowledge of a science. The first component, then, of the methods course concerns itself with modules on The Nature of Science, Conceptual Structure of Science, and the Analysis of Instructional Materials vis-a-vis the Nature of Science. Since our concern is with the teaching of science consistent with its nature, the above-mentioned modules are augmented with modules specifically relating to the teaching of science.

This second major area--Teaching Science Consistent with its Nature--includes modules such as: Stating Objectives Behaviorally; Evaluation of Instructional Objectives; An Intellectual Skills sequence of modules, each concerned with the utilization of one or more skills in the teaching of science; and, a Teaching Strategies and Techniques sequence of modules. The latter two sequences each contain culminating modules on Concept Formation via the skills and strategies examined in the two sequences.

A third major area of concern is The Nature of the Learner. This area includes modules concerned with: Theories on the Nature of the Learner and Learning, with writings by individuals such as Piaget, Ausubel, Bruner, and Gagné being analyzed; Motivation; The Gifted Student; The Disadvantaged Student; The Problem of Discipline, etc. While these are topics of a general nature, they are considered in this course in relation to the learning of science.

A fourth block of modules is concerned with Planning and Classroom Management. This component contains modules on Planning a Total Course, The Unit Plan (a conceptual scheme), as well as The Daily Lesson Plan, as centered around a specific concept or series of closely related concepts. Also included here are the related problems of Establishing and Maintaining Supplies,

CONTENT + STRATEGY —

List one (or more) major idea(s) from the conceptual framework for your science teacher education program.	For each major idea, state the teaching strategy you use (NOT just the "method") to implement that idea.
Understanding of the nature of science and its relation to science teaching. Three modules: Nature of Science; Conceptual Structure of Science; **Analysis** of Instructional Materials vis-a-vis the Nature of Science.	Flow charts accompany each of the modules directing students through a series of readings and activities, with intermediate seminars and subevaluations to determine student progress in understanding, and ability to implement ideas. Third module requires student analysis of major science curriculum project texts, etc. as to conceptual orientation, and content consistent with the nature of science.
Teaching science consistent with its nature--Several sets of modules. Example: Intellectual Skills Sequence (referred to as Processes of Science by others)	Series of modules for various specific skills and for combinations of skills. Flow charts accompany each of the modules directing students through a series of activities that will attempt to develop the skills for those whose pretests show deficiencies, followed by activities designed to enable the prospective teacher to incorporate skills into his course structure.

→ OUTCOME(S) ⇄	EVIDENCE
From the major idea and strategy you stated, list the outcome(s) you intend for your teacher candidates.	State the observable evidence you would accept, to establish that your teacher candidates have attained the outcome(s).
1. Student is to be able to recognize the consistency or inconsistency of science content and instructional methods with the nature of science.	Students are pre and post tested (TOUS and/or WISP) on understanding of nature of science.
2. Student should be able to organize content and instructional methods for a unit of study consistent with a conceptual mode and the nature of the scientific enterprise.	Students must determine evident concepts in a given chapter from a Project text and accompanying lab. Students must organize a unit of study along conceptual framework, integrating experiments, activities, and readings consistent with the ideas concerning the nature of science.
1. Student should be able to perform the necessary operations associated with the various skills.	1. Student must be able to identify skills in instructional materials.
2. Student should be able to incorporate various skills into instructional framework.	2. Student must be able to structure activities around designated skills.
3. Student should be able to provide the setting for his future students to acquire proficiency in these skills and to recognize them as an integral part of science.	3. Student must be able to demonstrate in micro-teaching situations his abilities with regard to 1 and 2 above, as well as to carry out the task of developing these skills in his "class."

Equipment, Facilities, etc., needed to carry out the lessons as planned.

The methods course, as structured here, met for two hours three times per week. In addition, an open-lab policy existed whereby students had an opportunity to utilize the laboratory facilities at other than scheduled class hours to develop and try out laboratory activities of their own design, as well as to try out activities that are produced by commercial sources.

With this arrangement, each student is expected to utilize the laboratory for this purpose on an average of two hours per week during a ten-week quarter. Modules for this Laboratory Component are developed for the purpose of providing guidance to the student in this phase of his work. The modules are closely related to those of the Intellectual Skills and Teaching Strategies and Techniques sequences. It is also obvious that they play a role in the Planning and Classroom Management sequence. As the AIBS Project BIOTECH progresses, certain of their techniques modules may become useful in this component.

Other broad areas can be identified as valid components in the professional preparation of a science teacher. Two of these, Science in the General Curriculum, that is, the relation of the science courses to the total picture of general education, and Science and Society, are very vital areas that need to be explored in order for the science teacher to gain a better perspective of his own role, as well as that of his discipline, as it relates to the total education of the child. Time limitations in the methods course have prevented indepth consideration of these topics. Under present course limitations, modules in these areas have not been developed, but will be as options.

Five blocks of modules have been identified as major components of the methods course:

1. The Nature of Science.
2. Teaching Science Consistent with its Nature
3. The Nature of the Learner
4. Planning and Classroom Management
5. Laboratory Component

Perhaps one of the major problems in the organization of a modular self-pacing approach, though not unique to it, is that of sequencing the modules. What modules are prerequisite to others? Can alternate pathways be established so that not all students need to proceed along the same route? The general efficiency of the modular approach depends, to a large extent, on determining alternate pathways, as well as allowing students to exempt certain modules if pretests show that they already possess the skills, and/or knowledge to be imparted via a given module.

Some of the primary advantages of a modular, self-pacing methods course are, obviously, its self-pacing nature, allowing a student to work at his own speed, pursuing a given idea as deeply as he desires, alternate routes to the same goals, pretesting out of modules in which he is already proficient, as well as pursuing optional modules of special interest. Finally, a modular approach may provide an alternative method allowing increased flexibility in teacher preparation.

AVAILABLE MATERIALS:

No wholesale distribution of materials is now available for segments of this program. Very limited samples of individual modules can be made available upon request. (Cost: Postage and approximately 6¢ per page. Module sizes vary from less than 5 pages to approximately 25.)

Video tape "Problems and Approaches in Self-Paced Modular Programs" (co-produced by W. Capie and N. G. Stauss) is available from School Science and Mathematics Association, Inc. This tape concerns itself with an Elementary Science Methods Course. It shares common features with the Secondary program described in the enclosed material. (Cost: Possibly mailing cost)

For materials write to: Dr. Nyles G.Stauss
350 South Pope Street, Apt. 7
Athens, Georgia 30601

SECTION FOUR: APPENDIX

ANTIOCH COLLEGE
Yellow Springs, Ohio

James F. Corwin
Antioch College
Department of Chemistry
Yellow Springs, Ohio 45387
(Telephone: 767-7331, ext. 426)

PROGRAM DESCRIPTION:

Available in an article published in the Journal of College Science Teaching, December, 1972.

AVAILABLE MATERIALS:

Approximately 100 copies of a report made to the Sloan Foundation on the organization and use of the Teacher Education Resource Center at Antioch College are available. Copies may be obtained by writing Dr. Corwin.

CALIFORNIA STATE UNIVERSITY, FULLERTON
Fullerton, California

Francis P. Collea
Department of Science and Math Education
California State University, Fullerton
Fullerton, California 92634

AVAILABLE MATERIALS:

Papers: "A Model for the Pre-Service Training of Science Teachers Based on the Intentions and Perceptions of First Year Science Teachers"

"Another View of a Methods Course: An Affective Approach" (co-author, David L. Pagni)

For copies, contact Dr. Collea.

CALIFORNIA STATE UNIVERSITY, FULLERTON
Fullerton, California

Dr. George C. Turner, Chairman
Department of Science and Math Education
California State University, Fullerton
Fullerton, California 92634

AVAILABLE MATERIALS:

Report, prepared by Dr. Turner and Dr. Francis P. Collea, entitled "The Urban Science Intern Teaching Project, a University-Community Action Program in Science Education."

For copies, contact Dr. Turner.

FLORIDA STATE UNIVERSITY
Tallahassee, Florida

Dorothy Schlitt
Florida State University
414 Education Building
Tallahassee, Florida 32306
(Telephone: 904-599-2269)

AVAILABLE MATERIALS:

Papers: "Quest: A Departure from Tradition at the Pre-Service Level"

"The Best Science Teacher Preparation Program"

Contact Miss Schlitt for copies.

HARVARD UNIVERSITY
Cambridge, Massachusetts

Gary C. Bates
Harvard University
Graduate School of Education
Room 324 Longfellow Hall
13 Appian Way
Cambridge, Massachusetts 02138
(Telephone: 617-495-3461)

PROGRAM DESCRIPTION:

Not provided.

AVAILABLE MATERIALS:

Information concerning "Classroom Vignettes" film which has resulted from teaching situations filmed for Project Physics. Pilot materials relate to a preliminary five session program designed to improve teacher candidates' observational and interpretative skills in interpersonal behavior.

Instructor's guide and "Classroom Vignettes" film are available in limited numbers (10) for research purposes.

Contact Mr. Bates or his advisor, Dr. Fletcher Watson.

UNIVERSITY OF ILLINOIS
Urbana, Illinois

Orrin Gould
University of Illinois
College of Education
Urbana, Illinois

AVAILABLE MATERIALS:

Several papers describing the Cooperative Teacher Education Program (CTEP) developed by the University of Illinois College of Education in cooperation with two public school districts are available by writing Dr. Gould.

UNIVERSITY OF NEVADA
Reno, Nevada

John H. Trent
College of Education
Department of Secondary Education
University of Nevada
Reno, Nevada 89507
(Telephone: 702-784-4961)

AVAILABLE MATERIALS:

Paper entitled "Interdisciplinary Environmental Science Workshop With a Multiplier Effect"

Contact Dr. Trent for copies.

THE OHIO STATE UNIVERSITY
Columbus, Ohio

Victor J. Mayer
Center for Science and Mathematics Education
244 Arps Hall, College of Education
1945 North High Street
Columbus, Ohio 43210
(Telephone: 614-422-4121)

PROGRAM DESCRIPTION (In-service):

Available in the form of an article entitled "A Summer Program for Preparing In-Service Teachers in Environmental Science" by Victor J. Mayer and Garry D. McKenzie. Contact Dr. Mayer for copies.

AVAILABLE MATERIALS:

Newsletter entitled "The Flexible Flyer"

OHIO UNIVERSITY
Athens, Ohio

Paul F. Ploutz
Ohio University
McCracken Hall
Athens, Ohio 45701
(Telephone: 594-2691)

PROGRAM DESCRIPTION:

Not provided.

AVAILABLE MATERIALS:

Evolution: a geological time chart game, designed to learn the eras and periods of the Geologic Time Chart. $6.70 per game

Elements: a competitive fun way to learn about solids, liquids, gases, non-metals, light and heavy metals, rare earth elements. $6.20

The Metric System: a programmed text for learning the metric system. $2.95, from the Charles E. Merrill Publishing Co., Columbus, Ohio.

Games may be purchased from the Union Printing Company, Inc.
17 West Washington Street
Athens, Ohio

TEXAS LUTHERAN COLLEGE
Seguin, Texas

Evelyn Streng
Texas Lutheran College
Seguin, Texas 78155

AVAILABLE MATERIALS:

Papers: "Action and Reaction: Classroom Teachers' Response to Use of Experimental Curriculum Materials by College Students" (presented at NSTA regional in New Orleans, November, 1972)

"Science Episode Teaching at the Secondary Level"

Contact Mrs. Streng for copies.

TUSKEGEE INSTITUTE
Tuskegee Institute, Alabama

L. F. Koom
Department of Chemistry
Tuskegee Institute
Tuskegee Institute, Alabama 36088

AVAILABLE MATERIALS:

Information on a summer institute for high school teachers of chemistry.

UNIVERSITY OF WASHINGTON
Seattle, Washington

Arnold Arons
Department of Physics
University of Washington
Seattle, Washington 98195
(Telephone: 206-543-6390)

PROGRAM DESCRIPTION:

Available in the form of an article published in The Journal of College Science Teaching, April, 1972.

AVAILABLE MATERIALS:

Compendium of unit outlines (including statements of performance objectives), tests, examinations. $10.00 per copy.

WEST CHESTER STATE COLLEGE
West Chester, Pennsylvania

Louis A. Casciato
School of Mathematics and Science
West Chester State College
West Chester, Pennsylvania 19380

PROGRAM DESCRIPTION:

Not available.

AVAILABLE MATERIALS:

Article entitled "How to Avoid the Curricular Crutch"

UNIVERSITY OF WISCONSIN-MILWAUKEE
Milwaukee, Wisconsin

Richard E. Haney
University of Wisconsin-Milwaukee
Milwaukee, Wisconsin 53201
(Telephone: 963-4831, 4814)

PROGRAM DESCRIPTION:

Information concerning undergraduate and graduate programs for science teacher preparation, K-12, may be obtained by contacting Dr. Haney.

Robert A. Roth
New Jersey State Department of Education
225 West State Street
Trenton, New Jersey
(Telephone: 609-292-4477)

AVAILABLE MATERIALS:

Papers relative to certification of teachers:

"Performance Evaluation Project, State of New Jersey, Department of Education"

"The Role of the State in Performance-Based Teacher Education-Certification"

Contact Dr. Roth for copies.

Charles A. Wall
2175 Lexington Road
Athens, Georgia 30601

AVAILABLE MATERIALS:

Mr. Wall has produced an annotated bibliography of historical documents in science education. Several documents relate to science teacher education programs. For copies of the bibliography, contact Mr. Wall.